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THE BRUSSELS ELECTRIC TRAMWAY.

M. G. MICHELET, Director of the Brussels Tramway Company, has recently read a paper based upon the experience gained during the last two years. The system employed was, as our readers are aware, that of Julien, and it was estimated that the cost for electric traction would not exceed 16 centimes per car kilometre, whereas the tramway company reckoned that the expenditure on the lines in question amounted, when running with two horse cars, to 25 centimes. If the conjecture of the supporters of electric locomotion had turned out to be correct the saving would have been nearly 40 per cent., but, according to M. Michelet, there is an actual loss in working by electricity.

It must not be overlooked, however, that the figures he presents are gathered from the results obtained by running three electrical cars only by means of the accumulator method; this number is obviously too small to render his calculations of any real value on a large scale.

The first great difficulty which seems to have been encountered was the weakness of the cells, which were so rapidly destroyed that the duration of the experiment became merely a question of time. It was found that the expense of maintaining the accumulators amounted to no less than 9 centimes per car kilometre, nearly three times the estimated sum. Now, this can only be accounted for in one way, *i.e.*, the cells were quite unfitted for the operations they were called upon to perform. This is all the more evident from the statement that at the end of 200 days they have to be taken to pieces and the positive plates renewed, but even under these circumstances Mr. Reckenzaun showed long, long ago, that under favourable conditions economical results might be obtained by employing secondary batteries in lieu of horse flesh; so to the cost of maintenance then we must look.

It is known that for some time past offers have been made to maintain accumulators for one penny per car mile, so it would be decidedly to the advantage of the Brussels Tramway Company's directorate to give these a trial in the place of those which, in their own hands, have cost half as much again. It is also quite certain that both Mr. Reckenzaun and Mr. J. S. Sellon have devised battery plates which will last in good working order for a far longer period than those of Julien, as demonstrated by these tests; and here again another opportunity presents itself, of which M. Michelet and his friends should not fail to take advantage, especially as he admits that their present efforts are wholly concentrated upon reducing the cost of maintenance of the accumulators and in improving the electric and mechanical apparatus. The dynamos, we learn, are of English manufacture, and answer very well; so assuming that the engine, car, motor, and transmission gearing are as efficient as the plant usually employed in overhead conductor or conduit systems, there is much to concern one in this report from Brussels, for it must be remembered that all data relating to electric traction by means of secondary batteries is more or less hypothetical. Estimates have been given with every assurance that the cost per car mile, with a minimum of 12 cars, would not exceed 3½d. or 4d. per car mile at the outside; but no figures obtained from actual practice on this scale have yet been available so that estimated and real cost could be compared. We are afraid M. Michelet's statement that the cost of electric traction in Brussels is as much as that of horse traffic, exclusive of maintenance of stationary engines, royalties to the inventor, interest on the capital sunk, besides depreciation of fixed and rolling stock, will be a bitter pill to swallow, but nevertheless we have sufficient faith in the men whose names we have mentioned, and other exponents of the accumulator method of running cars, to believe that they will be able to show that there is much in the Brussels report which should be discounted.

It will strike most people as seeming odd, to say the least of it, that the Julien system, for which commercial success has been claimed in New York, should fail ignobly in Belgium; at all events it would be

extremely interesting to hear Mr. Reckenzaun's reply to a matter which vitally affects the position which he has so long held, and in a manner which many had thought unassailable. It is possible that the track will be blamed, but that hardly meets the case, for if it were known to be unsuitable why was the accumulator method used ?

TYPE-PRINTING TELEGRAPH INSTRUMENTS.

AT the annual meeting of the Exchange Telegraph Company on July 31st, Lord Sackville Cecil, the new Chairman, explained the present position of the company's business, and then proceeded to speak of the Column Printer, which, it is generally admitted, will in time entirely supersede the tape instrument. His Lordship said they had read a good deal of late about a new column instrument which had been invented ; but he could assure the shareholders that the directorate had given their attention to this matter many years ago, and had taken out patents so far back as 1878. They had now a column printing machine which worked satisfactorily, and which they were prepared to supply to those customers who desired them. With reference to the threatened competition, he thought it would be a foolish proceeding if it was carried out. There was room for one such company in London, but not for two.

Mr. John Moore rose, and said that without going into the merits of the column printing machine possessed by the Exchange Telegraph Company and that which was to be run by the Central News Company, he would inform them of the reason why competitors had been brought into the field against them. The noble chairman had explained that there was only room for one such company as theirs in London ; yet, notwithstanding this fact, the Exchange Telegraph Company had for the past six or seven years attacked every existing news company, and it was scarcely to be expected that these new companies would stand quietly by and have their interests threatened without making some retaliation. It was this policy on their part which had brought about a competition, and which had really produced the column machine which was to be operated against them. The speaker gave instances of the unwarranted attacks which the Exchange Telegraph had made upon other news agencies in the provinces, and assured the shareholders and the directorate that the competition which had been threatened would most assuredly come.

It seems therefore highly probable that another legal suit will arise with the column printer as the bone of contention. It is unsatisfactory to shareholders to have their money spent in law proceedings, so perhaps Lord Sackville Cecil, who is both an engineer and electrician, will be able to steer the Exchange Telegraph Company away from the rocks upon which it might split. Nevertheless, if the patents which the company possesses have been frequently infringed, and we are informed that this is the case, one can readily understand the tone which the directorate has seen fit to adopt.

IN our last issue we gave an abstract of the report of the directors of the Gas Light and Coke Company, having special reference to the competition of coal gas with electricity and water gas. We then made no comment on the matter, but the *Economist*, in an article last week on the "Market Position of Gas Securities," states "that investors are right in attaching more importance to the one great factor in the future—the competition of electricity—than the directors of the leading gas companies appear to do can scarcely be doubted, but is is probable that they go too much to the other extreme. It is, of course, impossible to tell what use may be made of electricity in the future for illuminating and motive purposes, but it should not be forgotten that the gas companies have been for some time reducing the price of their gas, which puts them in a better competitive position, and that the use of gas for other than illuminating purposes is steadily increasing. Moreover, the means for improving the quality of the light obtained from gas have latterly been greatly increased, and if, as is not impossible, the companies became able to more effectually improve, without great expense, the illuminating qualities of gas itself, there would be much less disposition to abandon it for the electric light." Our contemporary has in this instance, as is not infrequently the case, made a great mistake. Even if the gas companies were able to improve the illuminating powers of coal gas to any considerable degree, the public would eventually to a great extent abandon it for the electric light. Why ? Because the latter will ere long be sold as cheaply, or nearly so, as gas ; because it has many advantages over gas, among which may be mentioned that it has no tendency to darken the ceilings and walls of houses, spoil the curtains, decorations, &c., thus saving what is now a great expense ; and because it is safer on account of its being non-explosive, and when glow lamps are employed the electric light is whiter and not so dazzling or heating as gas.

SAYS the *Standard* of Wednesday :—"The accident to the Leeds Express on Monday was of a nature to give added significance to the Regulation of Railways Bill, which stands for Second Reading in the House of Lords to-morrow. Following close upon the terrible catastrophe at Armagh, the later and lesser casualty points the same moral, in showing the importance of efficient brake power in the working of railway trains." We might also express the hope that the advisability of making electric intercommunication between passengers and guards compulsory on all railways has not been overlooked.

THE *Western Electrician* contains the following paragraph :—"Apparently it is known in Philadelphia just what electricity is. The following remarkable extract from the *Bulletin* of that city would seem to indicate that fact : 'Beginning October 1st the electric light furnished by the Edison Company will be $1.50 per 1,000 cubic feet, the same as gas. The company claims that 1,000 feet of electricity has as great illuminating power as 1,500 feet of gas.'"

IT is very pleasant to record such kindly feelings as must certainly exist, if we may judge from an article in our other pages, between Mr. John W. Mackay and the members of his staff. It is an example which might well be followed on this side of the Atlantic, and we feel sure that our readers will as much appreciate the spontaneous sentiments which prompted the *employés* to offer their gift as the hearty and kind words in which Mr. Mackay returned his thanks.

PARALLEL INTRODUCTION OF ALTERNATING CURRENT MACHINES AT MARIENBAD.

[FROM A CORRESPONDENT.]

I SENT you some weeks ago a short description of the electrical installation carried out at Marienbad with alternating current machines and transformers. This installation presents an especial interest from the circumstance that, as far as I know, it is the only one in which normal working is effected with alternating current machines in a parallel arrangement. It will therefore doubtless be of interest to your readers to learn some details concerning the working of this parallel insertion, especially as many electricians still doubt the perfectly successful solution of the problem, and some even question the advisability of an installation with alternating current machines introduced in parallel.

As I have already informed you, this installation was originally planned for two machines of 50,000 watts, each in action, and one of equal size in reserve. After the first few days of work the demand for light was so great, that in the hours of the greatest demand the reserve machine had to be connected to the other two machines. Meanwhile the municipality, which conducts the lighting on its own account, has ordered a fourth machine, which is at present being constructed.

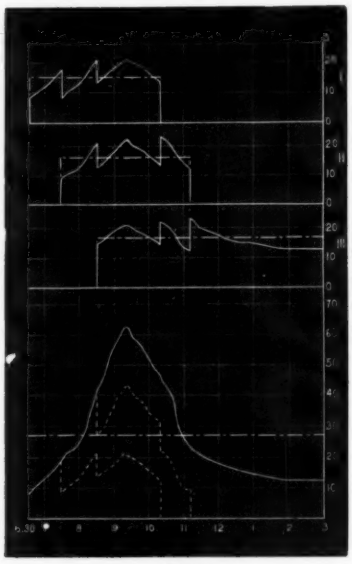

FIG. 1.

The accompanying diagrams, figs. 1, 2 and 3, show the consumption of current in three evenings' working, giving the primary ampères as they were read off on the ammeters of the several machines and on the main lead. Work begins in the summer season daily at 6.30 p.m., and continues until 3 a.m. At the commencement of work so many lamps were introduced, that the first machine when set in motion had at once to furnish 8—12 ampères; that is on clear week-days (fig. 1) 8 ampères, on dull week-days (fig. 2) and on Sundays (fig. 3) 12 ampères. From 6.30 p.m. the current increases regularly until a few minutes past 9 p.m. In consequence, the second machine is connected at 7.30 on week-days, and on Sundays at 7 p.m. The sudden changes which appear in the diagrams on connecting and disconnecting the machines are only apparent, since a load rheostat is always used, which can take up the entire yield of a machine, and which is introduced or disconnected in 24 graduations. The manipulation of the parallel introduction requires so little time, that the successive loading and unloading of the machine cannot be shown in diagrams on the scale here given. The third machine is connected on week-days at 8.30 p.m., and on Sundays at 8, as at this time the street arc lamps are introduced singly. The consumption of the current reaches its maximum at the closing of the theatre, a few minutes after 9, and then decreases

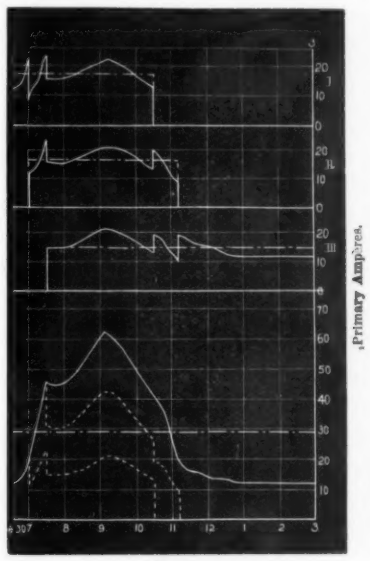

FIG. 2.

at the same rate at which it has risen. At 10.15 to 10.30 the first machine is disconnected, at 11.15 to 11.30 the second, and the third machine alone continues the service until 3 a.m., with 10—14 ampères for the street glow lamps and for some private lamps.

The sudden rise of the curve of the current at 7 p.m., in fig. 2, and the sudden decline at 7.30, will be noticed. The cause was a short thunderstorm which came on at 7 and cleared off again at 7.30, in consequence of which lamps in the town were disconnected.

From these diagrams it appears that this parallel insertion is successful as an industrial fact. The duty is distributed quite equally among the machines, *i.e.*, when two machines are running each gives the half of the entire current, and when three machines are connected parallel to each other, each furnishes one-third of the total ampères. The machines do this under all circumstances, although one machine is exerted sometimes below one-third of its normal capacity. The diagrams show also the evening means of the performance of the machines, and of the total consumption of current. It appears that the mean of the total current

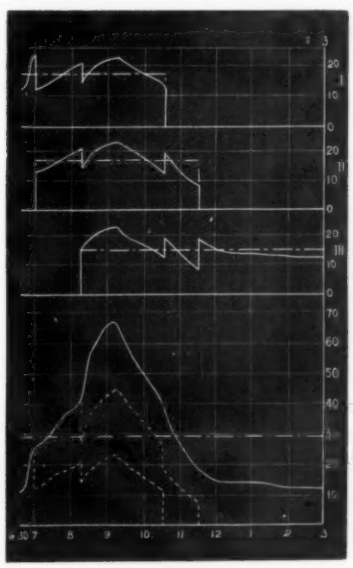

FIG. 3.

amounts to 42—47 per cent. of its greatest value, whilst the means of their separate performances rise to 76 per cent. of their separate maximum. If we consider that the installation as yet consumes at most 68 ampères, but will shortly reach its full duty, *i.e.*, 75 ampères, we may say that in such installations as that of Marienbad (*i.e.*, watering places without work in the day), the mean values of the performance of the several machines, in proportion to their capacity, are at least twice as high as the mean of the joint performance in relation to its maximum. The above-mentioned extension of the consumption of the current to 75 ampères will raise the apex of the diagram showing the sum total, whilst the width of the base of the triangle and its distance the axis of the abscissæ will scarcely vary, since the constant part of the illumination will be at once increased, whilst the diagrams of the several machines will be raised by 2—3 ampères in their entire length.

Hence we see the advantage of parallel introduction which has often been insisted upon, that the evening mean of the total degree of efficacy, and consequently their yearly mean, is higher than in case of independent machines, each of which supplies its own circuit. Fig. 4 represents the degree of efficiency of the larger Zipernowsky machines for different demands, and we see that the degree of efficiency at 40 per cent. of their capacity is about 82 per cent., whilst at 80 per cent. of their capacity it rises to 89 per cent. This difference in central stations with work during the day, and in

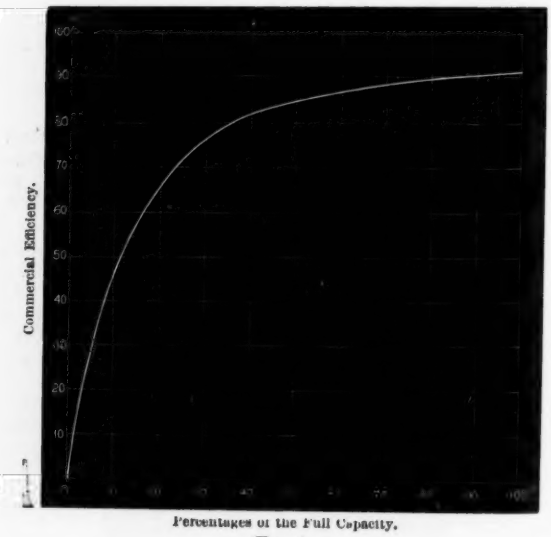

FIG. 4.

which the mean is only $\frac{1}{6}$th to $\frac{1}{4}$th of the maximum, is much greater as the degree of efficiency of the alternating current machine sinks to 60—65 per cent.

The small height of the mean charge in large central stations, in which compound steam engines are used in order to economise fuel, renders this economy quite illusory, if the machines are not allowed to act in parallel connection. Compound steam engines have the property, more than all other motors, of letting their degree of efficiency sink if slightly loaded.

COAL MINING BY ELECTRICITY.

IN the last issue of the "Proceedings of the British Society of Mining Students" an interesting paper on "Coal Cutting by Machinery" has been contributed by Mr. Herbert W. Hughes, the President of the Society. The author states at the beginning what our readers are already no doubt aware of—namely, that the application of electricity to mining in this country has not been carried out to the same extent as in the United States, probably because in the latter country a plentiful supply of water power is to be found ready at hand. The only motive power available until recently for working coal-getting machines was compressed air, but this system of holing has many disadvantages; with electrical transmission of power, however, fewer difficulties are to be found. According to Mr. Hughes, the general opinion held was that the E.M.F. in mines should not exceed from 500 to 700 volts; but he saw no reason why a much higher voltage should not be employed. This view, he said, was confirmed by the fact that at the Deptford central station the cables will carry a current at 10,000 volts, and they had tested the insulation with 100,000 volts. If, therefore, complete insulation could be maintained in the one case, why should it not be done in mines? Referring to the experiments carried out in this country with coal cutting machinery, he stated that at a colliery near Leeds the trials, which were considered fairly satisfactory, had been suspended owing to a breakdown of the machine.

In the United States two installations have been put down, and worked with great success. The machines used consist of a horizontal cutter bar armed with small steel knives set in a spiral, a semi-cylindrical cut being made at each revolution. The bar is usually 3 feet long, and can be pushed forward about 5 feet by a series of levers, so that 15 square feet ought to be undercut from one position of the machine; but in practice 13½ square feet is the general amount. When compressed air is used the driving machinery consists of a duplex engine, geared down 4 to 1 to reduce speed, and this drives a central chain belt connected with the cutter bar, giving it a rotary motion. Two small link belts complete the outfit, one being on each side of the cutter bar. These belts are provided with short projections and push back the cuttings produced by the steel knives and keep the undercut free for the advance of the machine. The depth of the undercut is about 5 inches. After completing one holing, 5 feet under, the machine is withdrawn and pushed along face by crowbars over the length of cutter bar used, and is then in the required position for making the next cut. When, however, electricity is used, the only difference is the substitution of an electric motor for the small pair of engines. The first coal mining installation was made at Drane Colliery, near Osceola, Pa. The engine driving the dynamo is of 25 H.P. The conductors are carried into the workings a distance of 1,000 feet on pegs driven into holes bored in the coal along the roadways. Even with such a simple arrangement as this no difficulty arose, and the machine commenced work immediately the motor was started. A 10 H.P. Sprague motor is employed, and is mounted on a truck which can be easily moved from place to place, as the weight is only about 9 cwts. The motor and machine are connected by means of a tarred hemp rope, running in V-shaped grooves on the motor and cutter pulleys. The mode of connection is such that the motor can be worked at a distance of 50 feet from the cutter. With this machine two men can excavate 100 tons of coal in 10 hours, and they do not require additional help in moving the machine. The amount of energy given off for work from the motor to the cutter is stated to be 70 per cent. The total cost of dynamo, motors, and conductors was £320, and the installation is said to give complete satisfaction. The second plant is at the Morris and Ellsworth Collieries, in Ohio. In this case the motor is placed directly on the coal cutting machine, and occupies the place of the air cylinders.

The above extract will doubtless be found interesting, but it is to be regretted that only three instances of the use of coal-cutting machinery driven by electric power are mentioned in the paper, as we are under the impression that similar installations are to be found on the Continent, and, again, in the States. There is, however, a possibility of detailed communications being shortly made public, as the North of England Institute of Mining and Mechanical Engineers have appointed a committee to report upon the use of coal-cutting machinery of all kinds. Mr. Walton Brown, of the

Neville Hall Coal Trade Office, Newcastle-on-Tyne, will, on behalf of the committee in question, be glad to receive particulars, prospectuses, plans, &c., of any machinery used for cutting coal, and especially as to the names of the collieries where coal-cutting machines may be seen at work.

THE TELEPHONE IN AUSTRIA-HUNGARY BETWEEN VIENNA AND BUDA-PEST.

AN arrangement has been concluded between the Governments of the Austria-Hungarian Monarchy which regulates the introduction of inter-urban telephonic connections between towns of the two halves of the Monarchy, and in particular contains conditions for the installation of a telephone line and its use between Vienna and Buda-Pest. In consequence of this arrangement the two Governments undertook to begin the construction of the line at latest on August 15th, and to complete it by the end of October this year. The Austrian Government will construct as far as Bruck on the Leitha, and the Hungarian Government will continue the line to Buda-Pest. Three leads will be laid down in the first place, two of which will be chiefly intended for the stock exchange business. The charge for a conversation, as on the Vienna-Brunn line, will be one florin, but the length of the conversation will be three minutes. Further urgent telephonic communications, like urgent telegraphic despatches, will be charged a triple fee, *i.e.*, three florins. Of course, in time, the telephone subscribers in Vienna and Buda-Pest will be brought in direct connection.

Telephonic Advice of Railway Cargoes on the Imperial and Royal Railways in Austria.

In the stations Vienna (Western terminal), Vienna, (Emperor Francis Joseph line), Linz, Salzburg, Trieste, Prague and Pilsen, from August 1st this year all parties in connection with the city telephonic nets can be advised telephonically of the arrival of their goods (whether by express or slower trains). The use of the Imperial and Royal Austrian State Railways result, after the previous delivery, of a written consent to the conditions involved, and in exchange for the delivery of an announcement on behalf of the consignees. On receiving the telephonic advice, the consignees have to fill up the telephonic advices. Such advice is a proof of delivery, in exchange for which the release of the consignment notes, and the delivery of the goods will take place.

CONTINENTAL ITEMS.

A ROYAL warrant has just been published in the Brussels *Moniteur* on the King's prize, naming the jury for the competition of 1889, and its principal features are as follows:—Mixed competition, 25,000 francs (£1,000), for the best work on the progress of electricity as a motor and as a means of lighting, on the applications which have, or may be, made of it, and on the economic advantages which are likely to result from the employment of electricity. The following gentlemen are nominated members of the jury:—MM. Montefiore Levi, senator, president; Cornu, member of the Paris Academy of Sciences; Gerard, professor at the University of Liége; Kittler, professor at the University of Darmstadt; Pontnière, engineer, professor at the University of Louvain; Chevalier A. Roiti, professor of physics at the Royal Institute of Higher Studies at Florence; and Sir William Thomson, professor at the University of Glasgow. M. Gerard will act as secretary to the jury.

The "Future of electricity," by M. Henri de Parville, in the *Débats* is *apropos* of the different methods of electrical purification of sewer waters which have been tried in England and Rouen: "It would be interesting to know how the water microbes get on. Are they killed? If it were so, it is evident that the method of electrical purification would be susceptible of numerous applications to domestic hygiene. Electricity would decidedly be very convenient. A little longer, and we shall be sold electric water in the guise of mineral water. Let us be patient."

After a day devoted to walks in Paris and a short visit to the Exhibition, Mr. Edison, accompanied by his family and numerous invited friends, went on Tuesday morning of last week to the Eiffel Tower, where he was received by M. Eiffel's representatives. A luncheon had been prepared in a private apartment above the third platform. After a concert, the principal airs from which were reproduced by the phonograph, Mr. Edison mounted to the lighthouse. He afterwards visited the different stages of the tower, and then dined with his guests in one of the restaurants on the first platform.

At the last sitting of the Paris Academy of Sciences, M. Lippmann made a communication on the laws of induction in non-resistance circuits.

A new limited company has just been brought out in Paris, under the title of Theatrophone Company, the promoters of the company being two engineers, MM. Bélisaire Marinovitch and Geza Szarvady. The objects of the company are the working in France and abroad of a system of telephonic auditions by means of an automatic apparatus patented in France in the names of the above gentlemen, and the purchase of all concessions and the necessary authorities for this working, the construction of apparatus and its installation, and the taking or acquisition of patents relative to telephonic auditions. The offices are at 3, Rue Gounod. The capital is fixed at 150,000 francs. There have been created for the founders 700 founders' shares giving a right to 70 per cent. of the net profits of the company. The directors are MM. Alfred Chatard, Gaston Crozes, Edmond Salomon-Constant Halphen, Prince Alexis Karageorgevitch, and Bélisaire Marinovitch.

CONTRIBUTION TO THE MANAGEMENT OF PRIMARY BATTERIES.

By Dr. LIEPMANN and E. L. MAYER.

ON pp. 152 and 293 of the present volume appear two paragraphs referring to the importance attached to the nature of the porous diaphragms used in the construction of primary batteries. It is there pointed out that, although the laws of electricity demand that the internal resistance, thus introduced, should be as insignificant as possible, other considerations necessitate a departure from those all important rules, simply in order to check the phenomenon of diffusion. This latter action forced itself upon the attention of all makers of primary two-fluid batteries to such a degree that other, equally important, points seem scarcely to have come to the surface. As we have had occasion to experiment with porous partitions that were treated according to Mayer and Liepmann's process, and which were thereby rendered almost free from the defect of diffusion, we have had an opportunity to make some observations that may perhaps be of a more general interest.

A. *Observations made on Chromic Acid Cells.*—As is well known, if cells of moderate dimensions are required to give out a comparatively large current, the porous diaphragms employed have to be of so "open" a structure that chromic acid diffuses freely into the compartment containing the zinc. This causes not only loss of depolarising solution, and an equivalent waste of zinc, but since chromic acid is able to oxidise even metallic mercury, the amalgamation becomes speedily defective, and the zinc dissolves quickly in the free sulphuric acid surrounding it. The porous diaphragms

used during the experiments that have led to the remarks following, allowed but slight diffusion to take place, its original intensity having been reduced through the treatment to $\frac{1}{7}$th and $\frac{1}{10}$th, whilst the resistance was nearly the same as that of similar plates not treated. When a cell equipped with such a porous pot, and charged in the ordinary manner, with chromic and sulphuric acid as depolariser and dilute sulphuric acid in the zinc compartment, was made to perform a large amount of work, the result was eminently satisfactory as long as the anode remained in contact with *free* sulphuric acid. After the free acid had disappeared, the current very quickly dwindled down most alarmingly. It was then found that the internal resistance had almost trebled itself. On examining the zincs, green specks, which consisted of a compound of hydrated oxides of zinc and chromium, were seen deposited upon their surface. The porous diaphragm was also covered with green and yellow deposits, the latter being, no doubt, a basic, hydrated chromate of zinc. Simple washing of the porous pot with water could not diminish the resistance, but soaking over night in dilute sulphuric acid restored its conductivity—a proof that the same compound was also precipitated inside the channels of the porous material.

The causes of these disturbances are not far to seek. After all the free acid had disappeared, the generation of the current was entirely dependent upon the electrolytically transmitted sulphuric acid, which (especially in cases where larger currents are concerned) is greatly deficient in quantity, as users of primary batteries know by experience. It is well known that metallic zinc, in contact with a strong solution of sulphate of zinc, is attacked under formation of a basic salt, and this latter, no doubt, appropriated some of the electrolytically transmitted sulphuric acid, causing hydrated oxide of zinc to be formed at the anode instead of sulphate. The small quantities of chromic acid present (especially when there is no free acid, or even enough neutral sulphate of zinc to carry the current), besides being reduced by the zinc in the ordinary manner, are transported by the electric current towards the anode, together with the oxygen which, under normal conditions, serves for the oxidation of the zinc, but which now is partially liberated in the active state; and active oxygen has the power to reduce chromic acid and to transform it into oxide, thus furnishing one constituent of the green flakes observed. As the solution becomes more and more charged with basic sulphate of zinc, it gives rise, by meeting the chromic acid inside the pores of the diaphragm, to the formation of a yellow insoluble deposit which obstructs the passage of the electric current.

From the foregoing it will be seen that cells possessing porous partitions not much liable to diffusion will have to be treated differently to those constructed with ordinary porous pots, and that devices serviceable in one case have to be discarded or adapted to the altered conditions.

In the first place, care has to be taken that the cells are thrown out of action *before* the *free* acid has totally disappeared from the liquid surrounding the zinc. Secondly, as long as the free diffusion which takes place through ordinary porous diaphragms supplies the excess of acid needed for the successful working of the cell, the zincs (when no large current is demanded) may be immersed in a solution of sulphate of zinc, or in pure water even. But where this diffusion and consequent augmentation of free acid fails, a surplus of acid will have to be supplied otherwise. Should it be inexpedient, for one reason or another, to make this addition of acid direct, the depolariser will have to be mixed with an excess inversely proportional to the rate of diffusion of the porous diaphragm.

B. *Daniell Cells.*—The foregoing remarks hold good also in the case of this class of cells. If the charge consists of a neutral solution of sulphate of copper and of pure water, or sulphate of zinc solution not acidified, the resistance of a porous pot which does not permit diffusion to take place pretty freely increases enormously after a short time. To prevent this, the zincs, if amalgamated, ought to be placed in a solution containing free acid, and in cases where amalgamation is not admissible, free acid, in not too small a quantity, will have to be mixed with the sulphate of copper solution.

THE PROPOSED ELECTRIC RAILWAY AT EASTBOURNE.

ON Monday night a public meeting, convened by the Mayor in compliance with a requisition which had been signed by a number of influential residents, was held at the Town Hall, Eastbourne, for the purpose of considering what steps should be taken in reference to a new electric railway which it is proposed to run along the sea front from Wish Tower westwards to Beachy Head. There was a very limited attendance, and the MAYOR, in opening the meeting, commented on the absence of the majority of those who had signed the requisition, observing that this was not treating him fairly as mayor. He knew upon authority that the nobleman who owned the land along which the proposed railway would run to Beachy Head would strenuously oppose the scheme. Before the new line could be constructed they would have to obtain an Act of Parliament, and many of the residents, also, would be opposed to the railway. He also read letters in which the writers stated that they would leave their houses if the railway scheme was proceeded with. He had done his duty in convening that meeting, and they saw the result.

Mr. ROBERT COOPER, who had been instrumental in securing many of the signatures, said that only about half-a-dozen persons had refused to sign the requisition. He argued that an electric railway would be a great boon to the public, and a great means of opening up Beachy Head. Many persons were at present unable to visit the Head because it was so difficult of approach. In all probability the proposed railway would terminate at the base of Beachy Head, and the summit could be attained by means of lifts similar to those now in use at Hastings and Folkestone. The proposed railway would no more do away with the cab traffic than the railway had done away with horses. Moreover, a railway to the Head would relieve the parades of the crowds who would get enjoyment by visiting Beachy Head. Opposition he took no notice of, for they were all well aware that many good things had been opposed at first. Having further expatiated on the beauties of the cliff scenery in the neighbourhood of the Head, Mr. COOPER moved "That Beachy Head being an object of great interest, but difficult of approach, it is desirable that facilities be provided to reach it by the construction of an electric railway." He knew nothing about the cost which the scheme would involve.

Mr. Cooper was interrogated as to ways and means, but he said he was unable to answer the questions.

The MAYOR said he could assure the would-be promoters of the scheme that many of the residents and owners of land were opposed to the proposal.

Ald. TOMKINSON stated that in addition to the consent of the Duke of Devonshire, an Act of Parliament would be required before the railway could be even commenced.

An ENGINEER told those present that the scheme would cost at least £5,000, exclusive of the lift.

Ald. TOMKINSON said that he should not oppose anything that was for the benefit of the town, but he really did consider that they ought to have some definite plans before they could decide.

Mr. COOPER here said that all he desired that evening was a resolution in favour of the scheme.

A GENTLEMAN, who stated that he knew Eastbourne as a visitor for the past 30 years, said that he should advise the town to oppose all attempts at introducing any electric railway along the fine sea front extending from Eastbourne to Beachy Head. He did not consider that the proposal would in any way benefit the town.

As no one seconded Mr. Cooper's motion, the meeting terminated with votes of thanks to the Mayor.

THE BIRMINGHAM EXHIBITION.

(*Continued from page* 179.)

WE understand that the prospects of this Exhibition are very encouraging, the admissions so far having steadily increased, indicating that the efforts made by the management to provide a popular entertainment are being appreciated. Some good music is provided; the garden, though small, is an agreeable smoking lounge, and the youths of Birmingham find attractions at the various stalls apart from those enumerated in the catalogue.

Messrs. W. and T. Avery.—The electrical weighing machine shown by this firm we described and illustrated very fully in our last. We are now able, through the kindness of the inventor, Mr Snelgrove, to give an illustration of a similar machine which is on view at the Paris Exhibition (fig. 1). This affords a better idea of the general appearance of the machines when in use than the figures already given. Mr. Snelgrove also introduced some time ago a patent adjustable electric bell, a new form of which is now shown for the first time at Messrs. Avery's stand. This bell, while possessing all the advantages of the original form—namely, slow and distinct strokes, powerful sound, and single and repeating action—has the additional recommendation that it is of stronger and simpler construction, and can be so readily adjusted, after fixing, to the available battery power that it is easily managed by the least skilful of workmen. In this bell (fig. 2) the magnet oscillates and the armature is a fixture. The current passes by way of the spring, B, through the magnet pole, A, and thence through the coil to the centre terminal. At the same time, therefore, as the magnet is attracted toward the fixed armature it attracts and carries with it the contact spring, B, during the entire length of stroke. The spring coming into contact with screw, D (which screw is in connection with the centre terminal) short-circuits the coil, and the magnet being demagnetised releases the spring, which flies back to the adjusting screw, C, to be followed and again carried forward by the magnet at the next stroke. The result of this arrangement is a slow striking, powerful bell, quite a distinct departure in electric bell work.

Nalder Bros. & Co. exhibit resistance coils, galvanometers, ammeters and voltmeters, Profs. Ayrton and Perry secohmmeters, and the testing instruments in general use. The D'Arsonval-Deprez galvanometer, fig. 3, presents some points of novelty in the shape of a strong practical design, rendering it suitable for general use, and in particular for engineers. The ammeters and voltmeters (Soames and Nalder) likewise intended for engine room use, are strongly made, and being constructed for use continually in circuit, all heating errors are compensated for. The secohmmeters, we understand, have been recently improved by providing two sorts of commutators, so that the galvanometer circuit, which was formerly short-circuited, is commutated, thus doubling the sensitiveness of the method.

Messrs. Alfred Hands & Co. show samples of their solid copper tape and rope lightning conductors, having a conductivity of 98 per cent.; a number of different patterns of elevation rods, with multiple points of very high finish, including some ornamental ones for the tops of flagstaffs; also a quantity of incidental supports and connections for various purposes, also electric bells, indicators and pushes. Two models are also shown, each about 6 feet high, of chimney shafts, one illustrating their system of laddering for the purposes of testing, repairs, &c., and the other the method of lowering heavy stone caps without expensive scaffolding.

Messrs. Fowler, Lancaster & Co.—Some elaborate work is here exhibited in the way of electroliers, pendants, standards and brackets in various styles and combinations of wrought iron, copper and brass, as well as the porcelain ware, to which special attention has been devoted by this firm for some years.

Woodhouse & Rawson, United.—Mr. A. H. W. Radcliffe, the Birmingham agent of this company, has got together a very interesting collection of telegraph instruments of various dates and specimens of both early and present day cables, illustrative of the development of this branch of the industry. At this stall is the most extensive and varied display of electric light switches as well as all the multifarious "supplies" with which the name of the firm is associated.

General Electric Company.—The handsome glass case fitted up by this company contains a wonderful variety of electrical accessories representative of the three departments into which the business of the company is divided, namely, electric light requirements, electric bells, and electro-medical apparatus. In the first division there are switches, cut-outs, ceiling roses, wall plugs, lamp holders and other fittings in a great variety of form and material; some pendants of hammered iron, and arc lamps in brass being specially worthy of mention. To this division also belong the voltmeters, ammeters, and electricity meters which the company produces in large numbers at its works at Manchester. In the way of bells, and every kind of signalling apparatus, there are representative specimens of all the leading goods of this class, the company making a boast that they stand at the head both in respect of the large quantities turned out and in the lowness of prices. The electro-medical apparatus shown includes induction apparatus, constant current batteries, electrodes, and the like, and it is to this company, we presume, that the small boys about the exhibition are indebted for the provision of electric shocks free gratis and for nothing by means of an automatic machine working constantly without the preliminary penny in the slot.

Edison and Swan United Electric Light Company.—This company provides a display which at night is the most striking of any in the exhibition. It consists of a glass show case filled with a large number of incandescent lamps ranging from the fairy lamp of ¼ C.P. up to the monster of 1,000. Many of these are coloured and the whole so tastefully arranged as to arrest notice. The case is surmounted by rows of 16 C.P. lamps with some larger ones intervening, the effect when these are all switched in being very brilliant. The new type voltmeters and ammeters of the company are also shown, as well as samples of the "tumbler" and other switches and a variety of fittings.

The National Telephone Co.—The space allotted to this company has been divided into three compartments, the front one being devoted to the display of various forms of telephonic apparatus at present in use, whilst the two back ones are set apart to illustrate a telephonic exchange in operation, and for the purpose of enabling visitors to test the long trunk lines now existing from the Great Midland Metropolis to various towns both north and south thereof. These two latter rooms have been rendered more interesting by the aid of the well known and tasteful decoration of Messrs. Liberty & Co., whose assistance has been called completely into requisition, even to the dress of the operator. The whole, taken at a glance, forms a pleasant sight. Taking the exhibit more in detail we find at the front thereof one of the usual iron standards from which the various lines connecting several stall holders within the Exhibition, together with trunk and junction lines to the main system. The leading in wires are led to a test board, the patent of Messrs. Coleman & Jackson, general managers of the company; this ingenious contrivance, providing both a test board and lightning arrestors, enables instantaneous tests to be made without the necessity of disconnecting the wires at terminals as in the more obsolete forms, thereby saving much time and inconvenience, at the same time ensuring reliable connections by means of rubbing contacts.

If we trace the connecting wires, next in order we find ourselves in a delightfully arranged room—the telephone exchange—before referred to: here the centre piece is a switchboard with a capacity for 80 local lines and for 12 trunk lines (metallic circuits). The switchboard has been specially designed by Mr. Alfred Coleman (general manager), and includes several patents by Messrs. Coleman & Jackson, of which special

mention may be made of the trunk line translator which has an iron shield to prevent induction from adjacent translators or coils, and by an ingenious device is made to act as annunciator, thereby saving four indicators, *i.e.*, one on local wire and one on loop line at each end, the increased efficiency obtained from such a sweeping away of the resistance of otherwise necessary

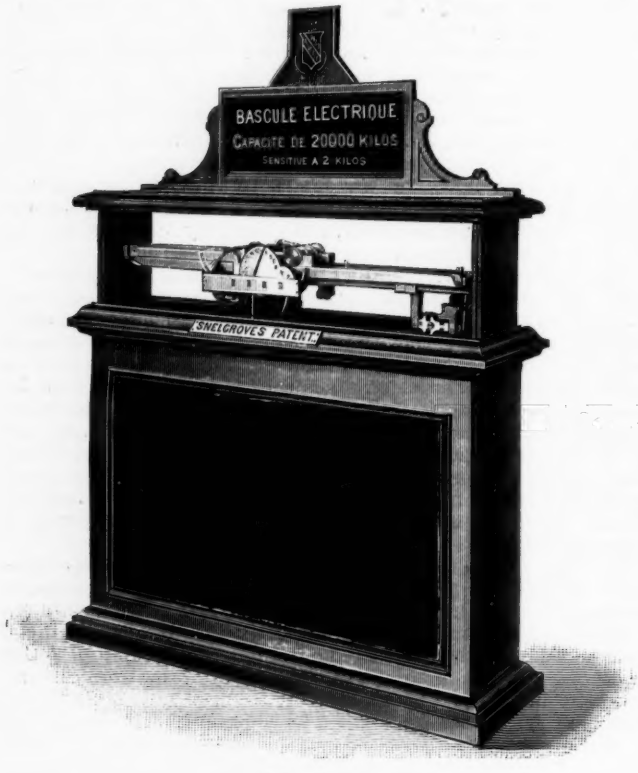

FIG. 1.

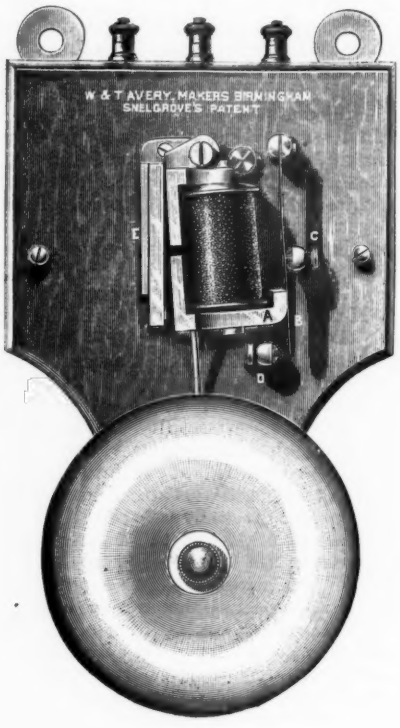

FIG. 2.

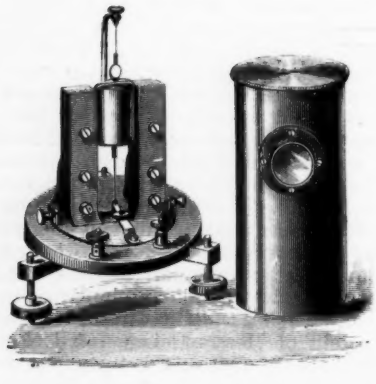

FIG. 3.

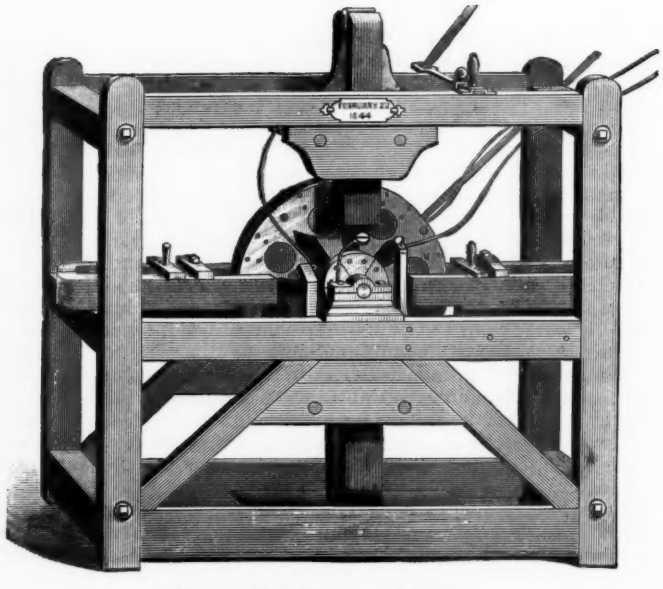

FIG. 4.—THE WOOLRICH MACHINE.

indicators is so clearly apparent as to render further comment unnecessary. The adjoining compartment has the appearance of a small drawing room, but on closer inspection we notice arranged to each settee or chair pairs of telephones, by means of which anyone can sit or lounge luxuriously and listen to strains of music from various towns even as far distant as Bradford (123 miles). A table set of telephones which can be handed round enables anyone so desirous to enter into conversation.

Returning to the front of the stall, where the miscellaneous collection is grouped, we find among the samples of apparatus shown portable telephones, an automatic exchange (Mr. Sinclair's patent), several different forms of Messrs. Coleman and Jackson's translators and switching jacks; Messrs. Coleman and Brown's indicators, and numerous forms of call boxes for the use of the public and subscribers, including a recent one, the patent of Mr. Arthur E. Cotterell, the district manager, which is constructed so as to be contained within one of the usual magneto instruments in

the position usually occupied by the battery, for which space is also provided. At the top of the desks are arranged two slits—one marked *pence* and the other *sixpence*. On dropping the coin specified through the slit provided, it is carried down in a funnel and strikes a special toned bell, and as the apparatus is attached accoustically with the transmitters through the backboard, the sound emitted by the bell can be easily heard and distinguished by the operator at the exchange. By an ingenious arrangement if coins of less value are dropped in no signal is given. For the convenience of subscribers special slots are fixed in the front of the box, and on a subscriber inserting a special token he is enabled to send a signal to the operator at the exchange which is clearly recognisable. These slots are two in number, one being for local subscribers and one for trunk.

Corporation of Birmingham.—The City of Birmingham has lent for exhibition a machine possessing considerable historical interest. It is stated to be the first electro-plating machine ever made, and the earliest industrial application of the scientific discovery of Faraday which lies at the foundation of the powerful electric machinery now so extensively used for the electro-deposition of metals, electric lighting, and electrical transmission of power. The machine was invented and patented by J. S. Woolrich in 1842 and constructed by Messrs. Prime & Son, of Birmingham, in 1844, who used it successfully in the deposition of gold, silver, and copper for many years till superseded by the more efficient machines of recent date. The machine is 5 feet high 5 feet long and 2½ feet wide. To afford a comparison there is shown side by side with this machine a small modern one called the Little Wonder, built by Harrison, Van Winkle & Co., of Newark, U.S.A., measuring only 14 inches high, 13½ inches long, and 20½ inches wide capable of depositing in a given time 10 times as much as the old machine with an expenditure of only one-tenth of the power.

W. T. Henley's Telegraph Works Company.—This company has contributed a large table with glass case containing coils of electric cable for electric light, telephone, and telegraph purposes. These are very effectively arranged, and as they include not only the heavier and more sombre varieties of cable, but also the small sizes of wire, covered in every imaginable combination of colour, the range is very comprehensive.

Automatic Standard Screw Company.—This exhibit, though only a small upright glass case, is well arranged, and impresses one with the idea that the work turned out is cleanly cut and accurate. Screws, terminals, and fancy turned work in iron, steel, and brass are shown in all the forms most in use.

Lacombe & Co.—This is the most comprehensive show of carbons we have ever seen. In addition to the ordinary forms of arc light carbons, samples are shown of the fluted carbons which are manufactured by this firm for the Trinity House for use in lighthouses and search lights. Carbon plates and cylinders for batteries and carbons for telephone and electrolytic purposes are also included, as well as the Lacombe improved Leclanché battery, by which the ordinary porous pot is superseded, With this battery a specially prepared salt is employed (instead of the usual sal ammoniac), which gives a clean wear of the zinc rod, preventing formation of crystals, thereby rendering the internal resistance and E.M.F. more constant. An object of some interest here is a sample of the original gas retort carbon used at Dungeness Lighthouse in 1862 in Holmes's apparatus. It is of 6½ mm., square section, and gave a light equal to about 750 candles.

The American Institute of Electrical Engineers.—The June and July double number of the "Transactions" of this society contains papers by Alex. S. Brown, on "Some results with secondary batteries in train lighting;" by Dr. Duncan, on "The inherent defects of lead storage batteries;" and by Francis B. Crocker, on "Electro-motor regulation."

REVIEWS.

A Study of Mr. Harness's Electropathic Belt. By A. E. BAINES. *Indisputable evidence concerning Harness's Electropathic Belt.* Compiled by Dr. R. Vigouroux and M. L. Loreau. Published by the Medical Battery Company, Limited.

On reading the effusion by Mr. A. E. Baines, "late editor of the *Electrical Engineer*, and late assistant editor of the *Electrician*," two thoughts occurred to us: first, that these papers have lost but little by having made other arrangements in connection with their staff; and, secondly, a feeling of pity that anyone who occupied the position that the gentleman in question is stated to have held could lend himself to the puffing of electro-medical appliances of the kind. Did this gentleman really believe that the apparatus which he advocates were really of a genuine character, we might criticise his arguments merely, but as the case stands we cannot do less than express disgust.

In plain language, we can only characterise the publication of this pamphlet written by Mr. Baines, and published by the Medical Battery Company, as another deliberate attempt to obtain money from the public in the usual objectionable way. Practically the whole of the matter in the pamphlet in question consists of a number of statements unsupported by a single proof that is worthy of the name of a proof; it is, however, written in such a way as to guide the public into the notion that whilst reading they are drinking deep draughts of wisdom, and that the position of the author as late editor and assistant editor of two well-known scientific papers entitles his statements to a very high value, totally ignoring the possibility that the word "late" may be open to several constructions.

As regard the compilations of Dr. R. Vigouroux and M. L. Loreau, we have before alluded to these gentlemen, and we can only add that we believe that they are tarred with the brush of Mr. Harness and his myrmidons.

Practical Photometry. A Guide to the Study of the Measurement of Light. By W. J. DIBDIN, Chemist and Superintending Gas Examiner to the London County Council. London: Walter King, 11, Bolt Court, Fleet Street, E.C.

The chaotic condition from which photometry is but now beginning to emerge has been in existence for over a century, and even now, great as have been the exertions of a few competent physicists, an entirely satisfactory universal standard has not been arrived at, although the pentane air gas flame of Mr. A. C. Vernon Harcourt, invented in 1877, is undoubtedly the nearest approach to perfection yet devised. The great difficulties in the way makes one appreciate Mr. Harcourt's labours in the matter, and the near approach to perfection and the undoubted value of the lamp would seem to render its provisional adoption as a legal standard most desirable. The great difficulty which one has in discovering what work has really been done in the art of photometry renders the publication of Mr. Dibdin's book most acceptable; probably no one more competent could have undertaken the work. The general contents of the book are as follows:—History of Photometry; Principles of Photometry; Horizontal Photometers; Radial Photometers; Jet Photometer and Illuminating Power Meter; Disc and Disc Holders; Standards of Light; Proposed substitute for Candles; Auxiliary Apparatus for Gas-testing Photometers; Examination and Adjustment of a Gas-testing Photometer; Colour Photometery; Stellar Photometry; Appendix. We notice the absence of any reference to the work of the late Mr. Schwendler, the late Mr. Robert Sabine, and of Messrs. Perry and Ayrton's in the matter of photometry; the "dispersion" photometer of the latter gentlemen is not even mentioned. The value of any photometer of course depends upon the

accuracy of which it is capable, but it is not clear in Mr. Dibdin's book to what degree any particular standard can be depended on; when the latter is spoken of we want something more than the general statement that it is very reliable.

JOHN W. MACKAY AND HIS STAFF.

IN our "Notes" last week we briefly mentioned that on Tuesday evening, July 23rd, a deputation of 15 members of the staff of the Commercial Cable Company waited upon President John W. Mackay at the Windsor Hotel, and made the formal presentation of the album, which was intended to accompany the silver piece sent to him Christmas day last, but which had been delayed by the difficulty in obtaining the signatures of the members of the transatlantic staff. From the *Electric Age* we learn that Mr. MORGAN WILLIAMS, formerly of Liverpool, acted in the capacity of orator, and addressed Mr. Mackay as follows:—

Mr. MACKAY: My colleagues have selected me for the honour of being their spokesman to-night for the reason, I believe, that before my appointment in New York I was attached to one of your stations in Europe, and am therefore familiar with your service on both sides of the Atlantic.

Our purpose is to complete a project which we have prosecuted with affectionate interest for some months past, and it now affords us much gratification to ask your acceptance of this album. It contains the address which was intended to accompany the silver piece on Christmas day last, and is signed by the entire staff of the company. The album has been delayed far too long in consequence of the difficulty of obtaining prompt return of the pages from the distant stations. Nevertheless we trust it may not, on this account, lose interest to you, but that it will prove a pleasing remembrancer of the success achieved by your company in a momentous contest, and a constant reminder of the esteem in which your *employés* hold you.

The past four years have been rich in events, having important bearings upon our future. Our admiration has been excited by your sturdy, unfaltering courage, during the most gigantic cable war which has ever been inaugurated—a war which was forced upon you by opponents of tried strength and of long experience in the methods of subduing competitors; opponents who were flushed with constant victories over others who have essayed to be independent; opponents who were intrenched in the possession of privilege and prestige; and yet, during all the struggle, animated by your noble example, the "Commercial" unflinchingly fought a stubborn and protracted fight until it attained the proud position of untrammelled independence by right of its own strength and excellence. And now, supported by an enlightened public opinion, the company has, we believe, entered upon an era of progress and success, and we give you the assurance that our efforts will be as earnest and unflagging in the future as in the past, and by unceasing vigilance place the service of the Commercial on the highest plane of excellence, and thus justify your confidence in us.

It was the consideration of the gratifying results here spoken of that caused the inception of the project of embodying the personal regard and pride with which we regarded you in some permanent form—a project which has had the hearty co-operation of every member of the staff, from our honoured vice-president, managing director, and general manager down to its youngest member, and a project which, taking the form of the silver piece, was intended to reach you on the fourth anniversary of the formal opening of the company to the public, and to be accompanied by the album which is now handed to you, which we beg you to accept in the same spirit in which it was conceived. We should like you to know that the album has been reproduced in sufficient number to provide each signatory with a copy.

It only remains for me, on behalf of my colleagues, to wish you and your family good health, long life, and continued happiness and prosperity.

Mr. MACKAY replied: Boys, I am very much pleased to meet you all, and I can only say that I deeply appreciate this unexpected present. I am afraid you have spent too much money on it, though. It is a beautiful album, and I thank you very much. I received the silver piece at San Francisco, and have it placed in my rooms there. I shall always treasure it very highly, and hand it down as long as my family lasts as a precious heirloom. You must convey to all the boys who were not able to be present here to-night, especially those at distant stations, my warmest thanks.

In your address you mentioned the cables. We have had war, but after war comes peace. We have peace now, and I hope it will continue for a long time. I think the success of the company has been due to the efforts and good work done by you and your colleagues on the other side of the Atlantic, to whom you must convey my earnest appreciation. I think the cables can be safely left to Mr. Ward and the staff.

At the close of the formal proceedings a most delightful evening was spent in social intercourse between President Mackay and his *employés*, during which remarks were made by Vice-President de Castro and General-Manager Ward, who, in proposing the health of Mr. Mackay, with musical honours, voiced the sentiments of all the staff when he said "we wish to say that we feel it a great privilege to work for you."

The album contained, among other good things, the following lines by Cableman John Morrison, of Canso, Nova Scotia:—

To John W. Mackay, Esq.

Tried chieftain, generous master, friend,
Whose words are deeds, whose thoughts are actions true;
In freedom's cause, oppression's power you rend;
Tributes of worth in honour's path you strew.

Long may kind wisdom grace thy noble brow,
And mark thy pilgrimage through life in peace,
So that the burden of thy work shall grow—
A lofty fabric, merit's proud increase.

And if, perchance, aught worthy there appears
In humble effort honour to bestow,
The sign of tribute which this volume bears
Is but a shade of gratitude we owe.

The following is by Cableman Poole Davis, of Bristol, England:—

How vast the chasm parting rich from poor
None know so well as they whose happy fate
Hath led them from the gloomy nether shore,
By paths adventurous, to the higher state.

And this, thy honour, Mackay. Thou dost know
The dreadful way between, yet dost not cease
To stretch out helpful hands to those below,
Bridging the gulf with human sympathies.

Thy tender feelings span the gulf profound,
E'en as thy cables the Atlantic span,
And with our thanks two continents resound,
All hail to thee, our kindly fellowman!

NOTES ON THE DYNAMOS AT THE PARIS EXHIBITION.

V.

TURNING to the American exhibits, we must now describe the dynamo designed by Mr. Charles Heisler, of St. Louis, for his system of lighting by low voltage incandescence lamps in series. The Heisler apparatus is almost unknown in this country, though some attempt has been made by the Bernstein Company to introduce here a system somewhat similar. One advantage of a series system of distribution is that we can waste in the leads as much E.M.F. as we like,

without creating any difference in the luminosity of far and near lamps, while an extension of the area of supply within certain limits necessitates only a length of additional wire sufficient to take in the lamps. But this is true only so long as a certain voltage is not exceeded, for obviously we cannot extend the area and increase the E.M.F. indefinitely. The highest E.M.F. employed by the Heisler Company up to the present time is 3,000 volts, and we imagine that with this voltage the limit is reached, so far as safety is concerned; in fact, many would say it is over-reached. The lamps are of 30 candle-power, nominal, and require each 14 volts, so on a single circuit there can be placed, allowing for the resistance of the line, something like 212 lamps in series. Now, when it is wished to extend beyond this number, another circuit must be erected, and if the extension is in the direction of the existing lamps, it means that the new circuit will lie alongside the one already up, this being in all respects equivalent to increasing the area of a main for extension when feeding transformers on the parallel system. It is easily seen that neglecting the loss in transformers, for a given weight of copper in mains and branches the loss in distribution is the same for a

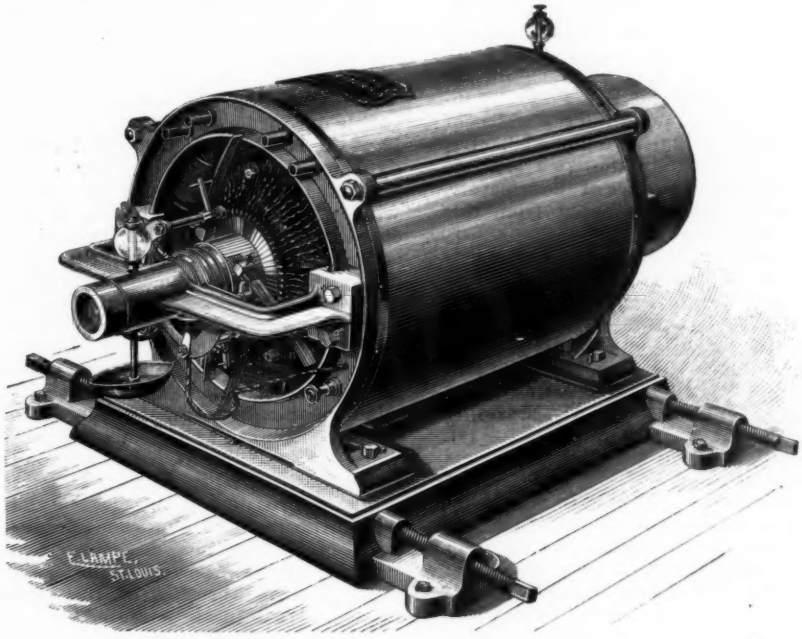

FIG. 1.

number of lamps supplied with current on the Heisler system, as for the same number supplied on the parallel system, provided the difference of potentials at the dynamo terminals is in each case similar. But while in the parallel system the difference in the brightness of far and near lamps depends on the size of the mains or on the E.M.F. wasted in them, in the series system all the lamps are of uniform brightness, and remain unaffected by any loss over the circuit. This constitutes the strongest argument in favour of a series system, but we must leave our readers to make any further comparisons they have a mind to between it and the better known system of distribution by transformers. It must be remembered that the loss in the transformers, amounting to three watts per 70-watt lamp when fully loaded and perhaps 10 watts when lighlly loaded, must be debited to the latter system.

The Heisler dynamo shown in fig. 1 is of the alternating current type, having a stationary ring armature and revolving radial magnets. On the shaft carrying the latter is fixed the armature of the exciter, which is Gramme-wound, and rotates in a four-pole field, both alternator and exciter being surrounded by a sheet iron casing as shown. The armatures of all sizes are wound in two circuits, each carrying 5 ampères, the machines being built for differences of potentials up to 3,000 volts, and to run at speeds from 600 to 800 revolutions per minute. The machine exhibited gives, at its normal speed of 640 revolutions, 1,750 volts on each 5 ampères circuit, supporting therefore 125 lamps in series or generating current for 250 lamps in all. These lamps are said to give a light of 30 candles each, but of this we could not judge by day. Thirty candles certainly seem a great deal for an expenditure of 70 watts, even when we remember that low voltage lamps can, without detriment, be run at higher efficiency than those of high voltage. The armature of the alternator, A, B, fig. 2, is built of wrought iron plates, in eight sectors, these being held in position by insulated phosphor bronze rods, secured to the two end frames. There are 32 coils in all, each sector being wound with four, as shown, and alternate coils being included in the same circuit. It will be seen that on withdrawing the phosphor bronze rods the sectors, with their coils, can easily be removed. The radial magnets are 16 in number, and fastened with their poles alternately, N and S, on a 16-sided cast iron cylinder. The coils in each circuit are equal in number to the magnet poles, and as the surface of the armature is almost wholly covered by the winding, the coils of one circuit occupy about half the surface, and have between them spaces in which the coils of the second circuit are wound.

The reason for winding the armature in two circuits will now be apparent. It is evident that when the E.M.F. of one set of alternate coils is maximum, that of the other is 0, or in other words, the induction phase of one circuit is a quarter cycle behind the other. Suppose the curves, A and B, fig. 3, to represent the E.M.F.s induced in the two circuits, time being represented by abscissæ. With the two sets of coils supplying different circuits of lamps, the total E.M.F. available is at any instant the sum of these two E.M.Fs., independent of their *direction*, and may be represented by the top wavy line, C, C_1, C. But if the two circuits were coupled in series, the E.M.F. would, at any time, be the sum of the two curves, with the direction of one considered plus and minus accordingly as it is aiding or opposing the other. Plotting out a curve to represent this result we get the line, D, C_1, D, C_1, the area enclosed by the induction curve being now much less than when the two circuits were independent of each other. We have lost the area shown by the darker hatched portion, and this shows clearly that part of the winding induces an E.M.F. in an

opposite direction to the other portion, hence the output may be not much more when all the coils are in series than when only one set is used. As a matter of fact in the best alternators only half the surface of the armature core is covered with wire, and this practice finds a splendid justification in the statement of the Heisler Company that when they couple in series the two circuits of the armature the output of their machine is only four-sevenths of its output when the circuits are

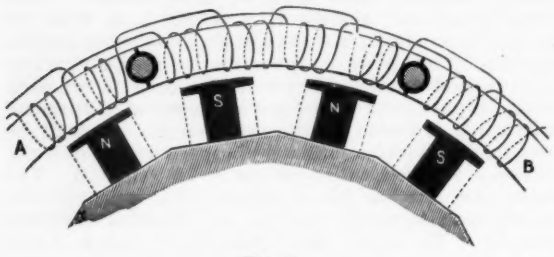

FIG. 2.

run separately. The ratio of the two outputs must depend on the disposition of the iron parts and several other things, the value here given not necessarily holding for other machines. It is, however, significant that in this particular alternator the E.M.F. is only increased in the ratio of 8 to 7 by doubling the width of the winding when a single circuit is employed. But by employing for his system of lighting two separate circuits and utilising the whole surface of the armature, Mr. Heisler gets nearly double the ouput from this machine for given carcase dimensions.

The exciter is series wound, and the current is collected by two sets of brushes 90° apart. The magnets consist of a ring surrounding the armature, on which are fixed four pole pieces, the portions between these being covered by the magnetising coils. The E.M.F. of the exciting current is from 75 to 80 volts, all the inducing magnets being joined in series. From the terminals of the exciter, exterior wires pass to brushes resting on insulated rings concentric with the axle, the ends terminating the circuit of the inductors being attached to these latter.

The most interesting part of the exhibit is an automatic regulator, upon the reliability of which the working of the whole system practically depends. For supplying lamps in series the current must be kept at a constant value, and our readers will remember that in describing previous machines we explained the action of regulators which corrected in a very effective manner the tendency of the current to increase or diminish. In one such apparatus a trifling variation in the current brought mechanism into action which moved the brushes backwards or forwards on the commutator; in another it brought into action mechanism which, by moving the arm of a rheostat, shunted more

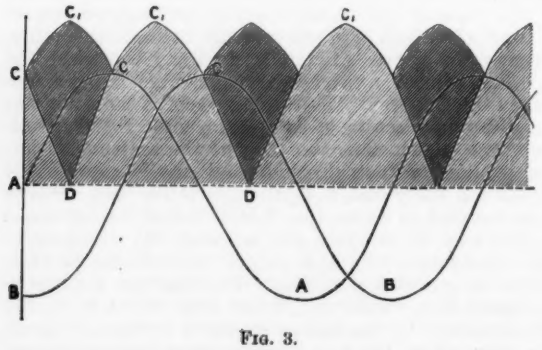

FIG. 3.

or less of the current exciting the fields. But in the Heisler system there are two circuits in which the current must be kept constant, and it is by no means certain that there will be at the same time a similar number of lamps on each circuit.

The circuits are kept in practice as nearly even as possible, and with the two running in the same direction, and lighting alternate lamps the number alight on each may not at any time be very different; still it is possible that they may under some circumstances differ considerably, and, accordingly, provision must be made for such condition arising. It is the function of the automatic regulator to keep the current constant in two circuits which may require for their respective numbers of lamps a different voltage, the adjustment required being therefore of a two-fold character. So long as the lamps on the two circuits are varied simultaneously the E.M.F. is adjusted by moving the brushes of the exciter on the commutator which alters the exciting current. But when by varying the lamps on one circuit only, the numbers are made dissimilar, a second adjustment is effected whereby a resistance is thrown into the circuit having the less number of lamps, this resistance absorbing an E.M.F. equal to the difference in the voltage requirements of the two circuits. Both the movement of the exciter brushes and the variation of the compensating resistances in the circuits are effected by the automatic regulator.

The regulator has a somewhat complicated look, but is really a most ingenious piece of mechanism. Its various parts cannot, however, be well shown on a diagram, and we must therefore content ourselves with explaining its action in such terms as will enable our readers to form a general idea of its working. It is enclosed in a wood case placed near the dynamo, there being one for each machine. The apparatus consists first of two circles of rheostat blocks with which two arms keyed to separate horizontal spindles make contact, and by their movements vary according to requirements the resistances in the two circuits. On the other ends of these rheostat spindles are keyed toothed wheels. Close to the peripheries of these and diametrically opposite are two pawls to which a reciprocating motion is given by cams fixed on an axle driven from the dynamo shaft. The current in each circuit circulates round a laminated iron core which is thereby magnetised, its action on an armature causing one pawl or the other to engage the toothed wheel and so increase or diminish resistance if the current rises or falls. When the current is normal the pawls reciprocate without either engaging the wheel. So far the regulator for each circuit differs only in detail from another described some weeks since. But it has to perform the additional function of moving the brushes on the exciter, and ensuring moreover that in the circuit with the greater number of lamps there shall be no resistance, there being only enough in the other to absorb the difference in the volts required for the lamps on the two circuits. This means that one of the two rheostat arms should always be in the position in which it short-circuits the resistance coils. Should the arm which happens to be in this position be caused to leave it by a sudden variation in the load, mechanism is brought into action at once which sets a vertical spindle in motion to move the brushes on the exciter commutator. This raises or lowers the E.M.F., and accordingly the pawls act to vary the resistance until the rheostat arm belonging to the circuit of most lamps again short-circuits the resistance coils. The vertical spindle referred to is geared by bevel wheels to a horizontal spindle having on its end a worm. This latter gears into teeth cut on a wheel attached to the brush carrier, which is not, however, shown in our engraving.

Outside the generating station every precaution is taken to ensure that the continuity of the circuits shall under all circumstances be maintained. If a lamp is removed or broken, an automatic device short-circuits the main, while for every consumer there is again a circuit closer, which in event of accident to the indoor wiring short-circuits the main where it enters and leaves the premises. This closer consists chiefly of a small magnet having wound on it a coil of about 200 ohms resistance. This is provided with an armature

which in its normal position holds back a copper bar, tending by the pull of a spring to short-circuit the mains. The coil being connected as a shunt to the house, the difference of potentials at its terminals is under normal conditions insufficient to attract the armature; but, should it rise above a certain value, the attracted armature releases the copper bar, which then flies up and effects a short-circuit.

It appears from the reports before us that the Heisler system has been installed in several towns in the States with considerable success. The company claims to obtain in working 490 watts per horse-power given to the dynamo, and in the practical erection of their circuits employ mains of such size as to lose in them 70 watts (one lamp) per mile. The details of the system have evidently been thought out very completely, and with great care.

The Edison Company, of America, has a very extensive exhibit, comprising all sorts of apparatus and appliances with which the name of the distinguished Edison has been from time to time associated. The Edison dynamo, as made by the American Company, must be well known to our readers, and an illustration is therefore unnecessary. Several machines of different sizes are shown, the largest with an output of 175,000 watts, and the smallest giving 2,500 watts. The current from the former, at a speed of 450 revolutions per minute, is 1,250 ampères, at a difference of potentials of 140 volts. This machine is rated for 2,500 lamps of 16 C.P., or 4,000 lamps of 10 C.P. The number of sections in the commutator is 41, the current being collected by six brushes on each pole, $1\frac{7}{8}$ inch wide by $\frac{5}{8}$ inch thick. The driving pulley is 3 feet 8 inches diameter by 21 inches wide. The machine weighs $12\frac{1}{2}$ tons.

We give in the following interesting table the principal dimensions of the different sizes of dynamos now being built by the Edison Company for the lighting of towns on the parallel series system. The difference of potentials is in all cases 1,200 volts, the current being divided into circuits of 3 ampères each.

MUNICIPAL SYSTEM OF EDISON.

Dimensions of Machines.

	X	A	B	C
Type...				
Volts, each circuit...	1,200	1,200	1,200	1,200
Ampères (normal)...	9	16	32	48
Watts	10,800	19,200	38,400	57,600
Engine horse-power	20	32	65	90
H.P. delivered by the dynamo ...	14·47	25·73	51·47	77·211
Maximum number of 3 ampère circuits	3	5	11	16
Number of sections in commutator	94	90	122	100
Speed	1,600	1,300	1,000	700
Diameter of pulley	9″	13″	17″	24″
Width of strap	5″	9″	11″	12″

(*To be continued.*)

ON A GENERAL LAW OF INDUCTION IN CIRCUITS WITHOUT RESISTANCE.*

By M. G. LIPPMANN.

1. We know that the electromotive forces of induction are, like the electro-dynamic actions, independent of the nature of the material in which the circuit is made; and, consequently, independent of the resistance of the circuit. It follows that, if we wish to treat of the laws proper to these phenomena, we may abstract the resistance. Of course, when once the general formulæ are established they may be applied to any special case, taking into account any resistances that may occur. We will proceed exactly as in applied mechanics, in which fundamental formulæ are established where friction is disregarded, only to be taken into account later on as a particular force. We will, therefore, endeavour to find the most general law of induction, supposing the resistance to be *nil*, and this method of procedure is, besides, justified *à priori* by the simplicity of the results, the facility of some of their applications and their agreement with recent experiments.

2. Let us suppose a circuit in which the sum of the electromotive forces is e, the resistance r, the intensity of current i, and the coefficient of self-induction L. We know that we get

$$e - \mathrm{L}\frac{di}{dt} - ri = 0. \qquad (1)$$

If the electromotive force, e, is due solely to induction, we get

$$e = \frac{d\,\mathrm{N}}{dt},$$

N being the flow of force (or the number of lines of force) contained in the circuit; this expression of e is, besides, quite general; it is applicable to the case in which there would be at the same time variation in the external magnetic field, displacement and alteration of the circuit.

We may express in the same way the term $\mathrm{L}\frac{di}{dt}$, which represents the electromotive force of the extra current, as a function of the flow of force, N′, due to the existence of the current, i, and passing through the circuit. Taking into account the signs, we get

$$\mathrm{L}\frac{di}{dt} = -\frac{d\,\mathrm{N}'}{dt};$$

on substituting these two expressions in (1), it comes out

$$\frac{d\,\mathrm{N}}{dt} + \frac{d\,\mathrm{N}'}{dt} - ri = 0 \qquad (2)$$

This being settled, let us make $r = 0$; the above equation is then reduced to

$$\frac{d\,\mathrm{N}}{dt} + \frac{d\,\mathrm{N}'}{dt} = 0; \qquad (3)$$

whence, by integration,

$$\mathrm{N} + \mathrm{N}' = \text{const.} \qquad (4)$$

Such is therefore the result which we obtain for $r = 0$, whatever may be the phenomenon of induction to be considered. In ordinary language: *In a circuit without resistance, the intensity of the current induced is always such that the flow of force passing through the circuit remains constant.* In other words, if the induced current did not exist, the variation of the magnetic field, the displacement, or alteration of the circuit would produce a variation, Δ N, of the flow of force, N, which was passing through the circuit; it is this very variation that produces the induced current; the circuit being closed and without resistance, the induced current is then at each moment such that it produces an increase, Δ N′, of the flow of force, equal to Δ N and of opposite sign. The inducing phenomenon and the induced current produce effects to a certain extent complementary. If we use the idea of lines of magnetic forces, we may express the same proposition by saying that *a circuit without resistance is impermeable to the lines of force.* Really, since owing to the induced current this number is invariable, it is because it is impossible to introduce into the circuit or take away from it, a single line of force.

3. As a corollary of the above theorem, we may mention a proposition which completes Lenz's law, in the case of circuits without resistance. When we displace or alter a circuit, the induced current gives rise to forces which tend, according to Lenz's law, to oppose themselves to the motion. The value of N being only a function of the parameters which define the form and position of the circuit, it is the same with N′, since

* *Comptes Rendus.*

$N + N' = 0$; consequently it is the same with the intensity, i, of the induced current; and lastly, it is the same with the electro-magnetic forces due to i. Thus these forces are functions only of the displacements as they would be of elastic forces.

In the case in which the induced circuit, in its initial position, is not traversed by any current, the electro-magnetic forces due to induction tend to bring it back to this position, and only become *nil* when it has returned to it; this position, therefore, is that of stable equilibrium. In the same way, a magnetised needle, deviating in the presence of a circuit, is brought back by the electro-magnetic forces due to induction to the position which corresponded to no current, as to a position of stable equilibrium.

To sum up, then, a circuit without resistance behaves, from the point of view of the attractions and repulsions produced, exactly like a diamagnetic sheet magnetised by influence; and we thus arrive, in a somewhat generalised form, at the theory of diamagnetism proposed by Weber.*

4. In order to show more clearly the signification of the formula $N + N' = \text{constant}$, we may solve the two following applications.

First Example.—A solenoid with resistance *nil* bearing n turns of wire per unit of length, and traversed by no current, has at first its axis directed perpendicularly to a magnetic field of intensity, H; we bring this axis parallel to the field; what is the intensity, i, of the induced current?

Solution.—The flow of force traversing the solenoid at the commencement being *nil*, remains *nil* constantly.

The value of i is then given by the equation

$$H + 4\pi n i = 0.$$

Second Example.—A solenoid bearing n turns of wire per unit of length is traversed by a current of intensity, i. Find the normal resultant, f, at the surface of all the electro-dynamic actions exercised by the solenoid on the elements of current covering the unit of surface. In order to solve this problem, let us imagine that the radius, R, of the solenoid undergoes a real or virtual increase, dR, and let us suppose at first that the internal magnetic flow remains constant. We then get

$$\pi R^2 H = \text{const.}$$

whence

$$R^2 dH + 2HR dR = 0;$$

we know, moreover, that $H = 4\pi n i$.

On the other hand let us suppose that the work furnished by the force, f, is equal to the diminution of magnetic energy; it then comes out

$$f 2\pi R dR = d(\pi R^2 U),$$

U being the magnetic energy per unit of volume; we know besides that

$$U = \frac{H^2}{8\pi}$$

On eliminating H and U and their derivatives in the above equations, and those deduced by differentiation, we find without difficulty that

$$f = 2\pi n^2 i^2.$$

5. Can we demonstrate experimentally that the conductors with a resistance *nil* act really as if they were impermeable to the lines of force? At first it may seem impossible, since it is not in our power to dimish indefinitely the specific resistance of the conductors under consideration.

However, some recent experiments of M. Hertz, instituted in this order of ideas, furnish this experimental demonstration. This physicist has shown that a metallic envelope acts as a perfect screen against *extremely rapid* inductive actions. Now, referring again to equation 1

$$e = L\frac{di}{dt} - ri = 0, \qquad (1)$$

we see that e, the electromotive force of induction, increases with the speed of the inductive variation; it is the same with the term $\frac{di}{dt}$. If this speed increases in the ratio of 1 to 300,000,000 (such are the numbers of variations per second utilised by M. Hertz), the two first terms are multiplied by this factor, while the term in r is independent of it, this last term then may be disregarded. It proceeds therefore as if the magnetic variation being unity, the resistance, r, were divided by a factor such as 300,000,000. And, in fact, a thickness of $\frac{1}{100}$th a millimetre of metal seems impermeable. If r could become strictly *nil*, the speed of variation as well as the thickness of metal would become indifferent.

ELECTRICITY AND GAS IN LIVERPOOL.

PRESIDING on Tuesday last at the annual meeting of the Liverpool United Gas Light Company, Mr. EDWARD LAWRENCE said that in view of the somewhat serious contingencies to be faced during the year, it would not be a wise policy on the part of the board to attempt any reduction in the price to be charged for gas. One special reason why they had to be careful and to husband their resources was that during the next year they would have to face the competition of the electric light. Whilst he did not think that they had anything to fear from free and open competition with electricity, they could not shut their eyes to the fact that to a certain extent it would interfere with the consumption of gas. But he did not consider it would be to such a degree to hamper the company or to injure them. At the same time it was one of those elements they had to consider when they were dealing with the question of reducing prices. And inasmuch as during the next year they might expect some little decrease in the consumption of gas from customers who would use the electric light, he thought the public would have to be satisfied with the price remaining at its present moderate amount. The directors did not forget the advantages of cheap prices in all such things, nor the important part which cheapness played in competition, and their object was to give to the public as cheap an article as they possibly could of the quality which was required of them by Act of Parliament. However, for the present they would, he was afraid, have to maintain the price at which it now stood, because it would be the height of folly for them to reduce it to day and perhaps six months hence have to increase it. He had several times been asked as to the prospects of the company and how far it was likely it would be interfered with by electricity. They all admitted that electricity was now being rapidly pushed forward; but from all he could gather in London he did not think that electricity would interfere to any extent with the gas companies, at least to their detriment. The consumption of illuminants went on increasing year by year, and

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* If the circuit contains other electromotive forces (ΣE) than those due to induction (that of a battery, for example) equation 1 is written

$$\Sigma E + e - L\frac{di}{dt} - ri = 0. \qquad 1a.$$

We may write it

$$\Sigma E - ri = \frac{d(N + N')}{dt}; \qquad 2a.$$

if $r = 0$, we obtain, by integration,

$$\Delta(N + N') = \int (\Sigma E)\, dt. \qquad 4a.$$

If, on the other hand, we wished to show the analogy existing from an analytical point of view between the electrical problem and the mechanical one, between the resistance and the friction, it is sufficient to designate as x the quantity of electricity. It then comes out $i = \frac{dx}{dt}$, and equation 1a becomes

$$\Sigma E + e - r\frac{dx}{dt} = L\frac{d^2x}{dt^2}.$$

We see that the electrical acceleration is in proportion to the sum of all the electromotive forces, and that the electrical resistance enters into this sum in the character of a special force which is negative and in proportion to the speed.

although electricity might take its place, there were some branches in which it was not possible for it to compete with gas; and so long as gas remained the cheap article it was, and so long as electricity remained the dear article it was, there was no fear of the competition of electricity interfering to any detrimental extent with the manufacture of gas. Of course they could not tell what science might do in the future, but taking things as they at present stood, and looking at the initial cost of maintaining it, he did not think there was any chance of any harm being done to gas in the competition. In conclusion, he informed the shareholders that the directors were taking every possible precaution they could to see that their interests were fully protected; and as to the public, the board were doing everything they could to discharge their duty to them in supplying the gas they were bound to supply at the lowest price at which it could be obtained.

In the course of the discussion which ensued, Mr. G. H. BALL expressed disappointment at the inability of the board to reduce the price of gas, although he agreed that it would be an unwise step to do so at present. With reference to electricity, he said he had had something to do with experiments that had been made with regard to the comparative cost of gas and electricity, and the result had been decidedly in favour of gas. In fact so much so, that in one institution electricity had been abandoned. And, further, owing to the improved methods of illumination by gas, it could be used far more economically than formerly. Oil had been in another instance found to be more economical than gas; but this was where the price of gas was 5s. 6d. per 1,000 feet, whereas it was admitted that in Liverpool, where the price was 2s. 8d. to 3s., it was far more economical.

Mr. J. STOLTERFOHT spoke of the use of gas for cooking purposes, and also said that in the metropolis there was very little fear as to the introduction of the electric light having any influence on the prosperity of the gas companies.

The CHAIRMAN, in answer to a shareholder, who wanted to know the position and prospects of water gas, replied that it was not at all likely to be in the smallest degree a rival. It might be applicable for certain purposes, but for ordinary purposes water gas was of no use.

OVERHEAD WIRES.

A SET of regulations has been issued by the Board of Trade affecting certain cases in which overhead wires have been used for the supply of electricity. In the first place, no aerial conductor is to be fixed in any part of any street at a less height from the ground than 20 feet, or where it crosses a street 30 feet, or within 6 feet of any building except where it is brought into a building for the purpose of supply. The maximum intervals for the supports are fixed at 200 feet where the direction is straight, and 150 feet where it is curved, and care is to be taken that all supports are of durable material and properly stayed against forces due to wind pressure, change of direction of wires, or unequal lengths of span, the maximum possible wind pressure being taken at 50 lbs. per square foot. No addition need be made for a possible accumulation of snow. Minute regulations are made for the efficient connection of supports to earth and for the provision of lightning conductors for supports of non-conducting material. Every aerial conductor is also to be protected by efficient lightning protectors of a pattern approved by the Board of Trade. The angle of crossing thoroughfares is not to be less than 60 degrees, with spans as short as possible, and precautions are to be taken against the possibility of crossing wires coming into contact with one another. Every high pressure aerial conductor must be continuously insulated with a durable and efficient material to be approved by the Board of Trade, to a thickness of not less than one-tenth of an inch, and in cases where the extreme difference of potential in the circuit exceeds 2,000 volts, the thickness of insulation must not be less in inches or parts of an inch than the number obtained by dividing the number expressing the volts by 20,000. This insulation must be further efficiently protected on the outside against injury or removal by abrasion. If this protection be wholly or partly metallic it must be efficiently connected to earth, so, however, as not to cause undue disturbance to other electric lines or works by electrostatic induction or otherwise. There are further regulations dealing with the specification of insulation, the *minimum* insulation resistance allowable, the suspension of conductors, the protection of telegraph and telephone wires from interference, and other detailed matters, and it is finally ordered that a notice describing every aerial conductor erected or used for the supply of energy shall forthwith upon receipt of these regulations be served upon the Postmaster-General, together with a plan showing the mode and position in which such conductor is erected, and that the Postmaster-General may require such alterations therein as he may think necessary for the protection of the works of the Post Office. Any failure to comply with his requirements is to be considered a non-compliance with the regulations.

NOTES.

Electric Lighting at Southampton.—At the last meeting of the Southampton Town Council, a letter was read from the Local Government Board with reference to the application made by the Council for sanction to borrow £1,440 for the purposes of electric lighting. The communication stated that the law officers of the Crown had been consulted as to whether local authorities were empowered to manufacture electricity for the lighting of streets, markets, and public places in their district, without obtaining a license or provisional order under the Electric Lighting Acts. Their opinion was that a provisional order must be obtained. Mr. Cleveland enquired what the cost of obtaining a provisional order would be? The Town Clerk replied that certain fees would have to be paid, but he was not certain as to the exact amount. The matter was referred to the Special and General Works Committee.

Proposed Electric Lighting in the Isle of Wight.—At a meeting of the Ryde Town Council held last week, it was resolved to invite the co-operation of the other Island authorities in opposing the application of electric lighting companies to the Board of Trade for provisional orders. It was, moreover, decided that the authorities should be invited to attend a meeting to deliberate as to the best mode of opposing the applications.

The Electric Light for Harbour Defence.—During the progress of the Naval Manœuvres the *Scourge*, tender to the *Defiance*, is anchored near the breakwater at Plymouth every night, and sweeps the sea with her search light, with the view of preventing hostile craft from approaching unseen. Search lights are also employed with the same object at Bovisand and Picklecombe Forts.

Attributed to the Electric Light.—Her Majesty's ship *Warspite* reached Plymouth at 12 o'clock on Monday night. As she was entering the Sound she came into collision with a Swedish barque. The *Warspite* was not much damaged, but found it necessary to bring the other vessel into harbour. The accident is attributed to the flashing of the electric light. So much has been said for and against the use of the electric light at sea that it is really high time to ascertain for a certainty whether it is a source of real danger to the seafaring man, or whether the light is made the scapegoat of careless and blundering navigators.

Electric Lighting at Launceston.—At Monday's meeting of the Launceston Town Council, a letter was read from the Devon and Cornwall Electricity Supply Company, asking the Corporation's sanction to an application to the Board of Trade for a provisional order, authorising the supply of electricity for public and private purposes within the urban sanitary area. Opposition was expected to the application ; but, to the surprise of the Council, acquiescence in the request was proposed by the chairman of the gas company, and seconded by the manager of the same undertaking. Under these circumstances, consent was at once accorded the application.

Electric Lighting at Penarth Dock, Cardiff.—The Taff Vale Railway Company has accepted the tender of Messrs. J. B. Saunders & Co., electrical engineers of Cardiff, for lighting the docks at Penarth. The installation is to be a very complete one, and will consist of 16 2,000 C.P. arc lamps on separate circuits of eight each, one 6,000 C.P. lamp, run from a separate engine and machine, and about 80 incandescent lamps for lighting the coal tips. The length of the longest circuit will be about a mile. Messrs. Saunders & Co. have placed the order for machines and arc lamps with Messrs. Paterson and Cooper, their Phœnix plant having given such very satisfactory results at an installation near Penarth. The engines are being supplied by Tangye's, Limited. The whole of the work is to be carried out in a most substantial manner, especial care being devoted to the outside portion, with a view of this being made thoroughly capable of standing the rough winters experienced in South Wales. Efforts are being made to have this important installation ready by the end of October. The two trains, which were fitted by Messrs. Saunders & Co. for the Taff Vale Company with electric lighting about six months ago, still continue to give most satisfactory results.

Electric Light in Japan.—Japan is rapidly adapting all the agencies which the civilisation of the West has called forth. As the latest phase of progress in this direction in Japan is the "laying on" of the electric light in the House of Parliament, for the illumination of which, by means of 350 incandescent lamps, a contract has recently been placed with the Electric Light Company of Tokio.

The United States Consul at Osaka reports that the Edison system is employed. The company consists exclusively of Japanese, and the machinery has been supplied from the United States. The light gives great satisfaction, and is growing into popularity throughout the Empire.

Electric Lighting in New Zealand.—On the evening of Friday, July 12th, the City of Wellington was illuminated with 500 incandescent lamps worked by turbines, alternating current dynamos, and transformers. About 86 miles of wire have been used for conveying the current through the streets, and the *New Zealand Times* devotes two columns to a description which contains revelations of the reporter's art. The installation is the property of the Gülcher Company, of London, and was erected by Mr. A. J. Baron, assisted by Mr. Cederholm, a representative of the company's colonial agents. The inaugural lighting is stated to have been a great success, and we congratulate the Gülcher Company on the very able manner in which the work appears to have been carried out. Wellington is indebted to Mr. Brown, ex-mayor, for this great boon.

The Progress of the Keswick Electric Light Company.—The Keswick Electric Light Company are pushing on their apparatus. They are putting the wires into the houses and shops, and have already got them fixed up in St. John's Church chancel, which is to be lighted by the new light. The workmen are excavating where the turbine wheel is to be placed, and preparations are being made for the erection of the central station. The company expect to have the light ready for use by October 1st.

Salford and Electric Lighting.—A special meeting of the Salford County Borough Council will be held on Friday, September 20th, in the Town Hall, Salford, to consider a notice given, pursuant to the Electric Lighting Act, 1882, by the Manchester House-to-House Electricity Company, Limited, of the company's intention to apply to the Board of Trade for a provisional order, to be confirmed by Parliament in the session of 1890, to authorise the supply of electricity by the company for public and private purposes within the area of the county borough of Salford.

Liverpool Electric Light Inspector.—At a special meeting of the Watch Committee of the Corporation, held on Wednesday, the question of the appointment of an electric light inspector, at a salary of £150 per annum, was to be considered. The committee had received 47 applications for the post, which were upon examination reduced to seven.

Street Lighting in Montreal.—On August 1st Montreal was to enter upon a new phase in the history of its street lighting. The whole city, according to the Council's contract with the Royal Electric Light Company, was to be lit by electricity. No less than 2,379 gas and 671 coal oil, a total of 3,050 lamps, are to be replaced by 753 arc and 346 incandescent electric lamps.

The Standardising Laboratory.—Mr. Kenric B. Murray, the Secretary to the London Chamber of Commerce, has issued the following circular to the Electrical Trades Section :—"As there appears to be some misunderstanding on the subject of the recent circular sent out by this Chamber, respecting the proposed Government standardising laboratory, at the suggestion of Mr. Crompton, Chairman of the Section, I beg to call your attention to the following facts. I have called on several of the leading instrument makers and asked them their opinion as to the value of the Kew certificates. I am informed that whereas the fee for examining thermometers, barometers and sextants is very small, that is to say averaging between the limits of 1s. and 2s. 6d., the instruments carrying these certificates command from 20 to 25 per cent. higher prices. The watch certificates are given to a comparatively small extent, but similarly their value becomes enhanced to an extent far exceeding the amount of the fees. It appears further to be admitted that the laboratories established by foreign countries at Berlin and Paris are used to a considerable extent for the certification of voltmeters and ammeters, in addition to the principal work of testing house meters. These certificated instruments command a better price than those which are sold merely on the makers reputation. The British trade is placed at a disadvantage on the foreign market, as foreign-made instruments with such certificates are preferred to English instruments without them. I also wish to call your attention to the fact that all instruments used under the Electric Lighting Acts will have to be certified, and it is obvious that the purchaser of such instruments will prefer to buy them of a maker of such certified instruments rather than take the trouble of getting them certified himself. Should the above facts cause you to modify your views I should be glad if you will send in another return of the probable number of instruments you are likely to send in for certification. The returns of house meters which have already been received from five sources only amount to nearly 17,000 per annum."

Electric Light for the Million.—This is the title of a little handbook for the uninitiated, of concise practical information on electric lighting and its cost. The author is Mr. A. F. Guy, and it is published at the small price of 6d. by Messrs. Simkin, Marshall and Co. It may be recommended as an attempt to place before the general public a sketch of the advantages possessed by the electric light over all other kinds of illuminants, and also to induce gas companies to consider the advisability of becoming purveyors of electrical energy.

The International Congress of Electricians.—Those gentlemen who are attending this meeting in Paris will have their time pretty fully occupied. To-morrow morning a sort of reception will take place, and in the evening M. Egoroff will discourse upon electrical undulations. Early on Sunday morning the Eiffel Tower will be ascended and the observation instruments inspected; Monday, Wednesday, and Friday will be devoted to visits to the Exhibition; on Tuesday the Central Electrical Laboratory, the works of the Société Générale des Téléphones, and those of MM. Sautter and Lemonnier will be invaded; the electrical works of the Palais-Royal and the Opera will be open to the members on Thursday, and on Saturday, after the close of the Congress, the foreign members will be entertained at a banquet by their French colleagues.

Eiffel Tower Struck by Lightning.—The correspondent of the *Daily Telegraph* writes:—"It is now quite certain that the lightning struck Eiffel's Tower heavily on Monday night, but no damage was done. All those who were on the structure at the time felt a tremendous shock, and the chief electrician reports that some molten metal fell from the lightning conductors."

Jack Ashore.—On Tuesday week, Prince George of Wales, who is in charge of a flotilla of torpedo boats, in connection with the naval manœuvres, spent Monday night at Dunmore East, and the great popularity of his Royal Highness with the sailors led to a jolly time being spent. One hundred of the tars came ashore till eleven o'clock, and when darkness set in the search light was laid on, this producing a startling effect on the town. The light was suddenly thrown on to a romantic spot known as the Island, where, on the authority of the *Weekly Times and Echo*, we learn that several tars were caught with Dunmore lasses, with whom they had struck up acquaintance on short notice. Their discomfiture on being disclosed to those on board the gunboats caused great merriment, especially when the embarrased victims uselessly attempted to escape, for at every step they took the light followed them.

New Electrical Works.—Messrs. C. A. Parsons & Co. are building extensive new works at Heaton, Newcastle-on-Tyne, for the manufacture of all descriptions of electrical machinery. It is expected that these new premises will be completed in about two months' time, when the business, which is at present carried on at the works in Park Road, Gateshead, will be removed.

Electric Traction.—*Apropos* of an article at the commencement of our pages, we should not be surprised to see the Bentley-Knight system tried in this country before very long. We should welcome it most cordially, for it ought to accomplish here what it has succeeded in doing in America, where its commercial success was long ago assured.

An Electric Company becomes a Nuisance.—At a recent meeting of the Eastbourne Town Council a memorial was read from inhabitants of the district, near the electric light company's works, complaining of the nuisance caused by the smoke and smell. Eventually it was decided to give the company notice to discontinue the nuisance.

New Electric Plant for Blackpool.—An interesting addition to the Blackpool Corporation Gas Works is the first section of the new electric light plant for the extension of the beach lighting. An installation, consisting of a Brush Victoria dynamo, with resistances and instruments, has been placed in the exhauster house. It is driven from the spare exhauster engines, which are larger than usual and on separate beds, the speed being obtained from a counter-shaft. Two extra lamps of 6,000 C.P. are lighted on the beach, making eleven in all.

The E.M.F. Curve of a Westinghouse Dynamo.—We shall hope to publish in our next an abstract of a paper by Messrs. Lewis Searing and Samuel V. Hoffman, entitled, "The experimental determination of the law of variation of the electromotive force in the armature of a Westinghouse dynamo." It is curious that it should be so nearly a sine curve, but we don't think anyone can predict these things. We believe that either Prof. Ayrton, Mr. Swinburne, or Prof. Forbes once said this would come out a saw-tooth curve.

The Magnetic Circuit.—In the May issue of the *Technology Quarterly*, which is issued under the auspices of the Massachusetts Institute of Technology, there appears a lengthy paper by Edward Collins, on "The magnetic circuit: a theoretical discussion, including a formula for magnetism in soft iron."

The Uses of Oil Engines.—A Priestman oil engine of 8 H.P. has just been adopted by G. W. H. Brogden, Esq., at the Bwllfa and Merthyr Dare Collieries in South Wales, for pumping, where it is working well and giving great satisfaction. Heretofore the pumps for clearing the workings have been put in motion by an endless wire rope worked by means of a hauling engine, with the many objectionable attendant details and serious expense in wear and tear so well understood by colliery engineers. The Priestman engine is coupled up direct to a set of three throw pumps 6 inches by 12 inches, dispensing with the wire rope. By this means the dip is being worked to greater advantage, as the pumping and hauling are now kept entirely distinct, and a better illustration of the advantages which the makers claim for the engine could hardly be obtained, as the fact is clearly demonstrated that motive power can be employed in restricted positions where it would be impracticable to use steam power, and at a much less cost. The practical advantages which this engine possesses for a very large variety of work was strikingly recognised by the Royal Agricultural Society, who awarded it the silver medal at Nottingham last year for the horizontal type and a silver medal at Windsor in June last for the portable type, being the only award ever given by the Society for "liquid hydrocarbon engines."

Electric Traction in Boston.—While the West End Company of Boston, with 250 miles of street railway, has just voted to raise $4,500,000 for equipping its lines with electricity, the Third Avenue Railroad Company of New York is, according to *Electric Power*, striving to get permission to use the cable, because its officers think electric traction is not a success. By the time the cable line is finished, that system will be decidedly antique. The authorities of Newark, N.J., have issued an order that the cable conduit with which the street railway people have been experimenting for a long time shall be removed within 60 days.

Interesting Figures.—An inscription has been placed over the American section in the machinery hall in the Paris exposition which, though brief, is full of interest. It states that the United States possesses steam engines of 450,000 horse-power, the power of which is transformed into electrical energy; and that, apart from transmission of power, this energy is used to supply current nightly to 2,000,000 incandescent lamps and 250,000 arc lamps.

Country Electric Tram Lines.—The meeting to discuss the project of an electric tramline between Eastbourne and Beachy Head, which we publish in another place, indicates the kind of feeling with which all efforts towards progress are generally met in local towns whose inhabitants depend to a great extent upon visitors for a livelihood. There is little doubt that if Mr. Cooper's scheme were carried out it would materially benefit the town and not in any way interfere with its beauty or other attractions, and probably where one person now goes to Beachy Head fifty would be found if easy means of access were given.

The Pacific Cable.—We published in a recent issue the official report of the survey recently undertaken in the Pacific Ocean by H.M.S. *Egeria*. We understand, on good authority, that so far as the survey has gone the result is regarded with considerable satisfaction by those who look forward to the early establishment of a cable route from British Columbia to Australasia by way of the Pacific Ocean. There is nothing, it appears, in the features of the sea bed so far reported upon that need present any difficulty; while the depths are not excessive on the route likely to be selected. Moreover, it transpired at the proceedings of the Colonial Conference that coral reefs are only injurious to a cable when found at or near the surface of the water, and liable to cause friction in the neighbourhood of the cable. In the case of the route surveyed in the Pacific Ocean there is no evidence as yet of any coral reefs which are likely to present obstacles in this respect. The main object of all concerned should now, of course, be to expedite the completion of the survey.

Utilising the Tide.—A correspondent writing to the *Dundee Advertiser* of August 17th, says :—"Might not Dundee be cheaply lighted by electricity if the power of the tide was used as follows:—Enclose a portion of the Firth with a suitable wall; let in the flowing tide through turbine wheels when the water is high and the pressure great; let out the water in the same way when the river is low. The amount of electricity generated would depend on the amount of water passing in and out, and the pressure exerted."

Telegraphy in Honduras.—The American Consul at Tegucigalpa states that the telegraph system of Honduras is owned and controlled by the Government. There are 1,717 miles of telegraph lines in operation, with 68 offices and 252 *employés*. The secretary of the Treasury Department reports that the expenses of the telegraph system, as also those of the post office, are always in excess of the income.

Edison in Paris.—The little differences between Mr. Edison and the French *savants* have been adjusted completely and satisfactorily by the visit of the American electrician to the Academy of Sciences. The phonograph and its inventor once drew forth the terrible word "Humbug!" from a French man of science, but there was not a spice of sarcasm or cynicism in the welcome accorded by the assembled academicians to Mr. Edison, who was presented to them by M. Janssen. Before leaving, Mr. Edison asked M. Janssen to tell the academicians that on his return to America he would send one of his perfected phonographs to the institute, accompanied by numerous inscription rolls. Each academician could address a long conversation to the phonograph, and this being taken down on the rolls, it could be placed in the library, or elsewhere, for the benefit of future generations, who would then be able to tell how the great *savants* had spoken, and would hear the accents of their voices long after they had disappeared from Life's busy scenes. The idea of making this gift to the academy occurred to Mr. Edison as he was examining the busts of deceased academicians —and notably that of Ampère—in the Salle des Pas-Perdus of the institute. The offer of the electrician was warmly applauded, and Mr. Edison then took his leave, having reiterated his thanks for the enthusiastic reception which had been accorded to him by the great scientific luminaries of France, whose names and fame he would always venerate. A special library will be fitted up in the academy for Mr. Edison's phonographic apparatus.—*Daily Telegraph.*

A Trooper Killed by Lightning.—The Berlin correspondent of the *Daily News* says that as a detachment of the 1st squadron of the 2nd Lancers, consisting of a corporal, a trumpeter, and three men, was returning from the manœuvres at Spandau, and was riding during a thunderstorm in the Thiergarten, by the Spree, a flash of lightning struck a tree close to them and glanced off from it into the middle of the troop. Both riders and horses were hurled to the ground. Two of the men remained motionless, whilst the horses rolled over and over, struggling wildly. The trumpeter recovered first, and soon two of the troopers were able to raise themselves from the ground, and these three men succeeded in raising the horses. To their horror they then perceived that the corporal had been killed on the spot, as well as his horse. The third man was paralysed, and his horse only recovered slowly.

Ourselves.—On Tuesday last the annual staff dinner of the ELECTRICAL REVIEW was held at the Mitre Hotel, Hampton Court, and although we were less super-elated than an esteemed contemporary, inasmuch as we had no jaunty chairman to tell us that we were the *only* representative of electrical science in the United Kingdom, still we managed to make the day pass agreeably. The electric launch *Volta*, owned by Messrs. Stephens, Smith & Co., had been sent to take our staff and friends for a river trip, and Messrs. Immisch and Co., in the kindest possible manner, placed one of their own delightful boats at our disposal, their new charging station at Platt's Eyot being but a short run from Hampton Court. The afternoon was thus spent in a most enjoyable manner, and in the evening the *Volta* took the entire party to Richmond, the railway being there requisitioned to enable us to reach London at a respectable hour. We appreciate the courtesy of Messrs. Immisch & Co. all the more because of its spontaneous nature, for they only became aware of our intentions and *rendezvous* at the last moment, and we tender to them and their courteous assistant, Mr. Wade, our cordial thanks for an act which conduced not a little to making our trip a memorable one. To Messrs. Stephens, Smith & Co., and to Mr. Reckenzaun, our thanks are also due for the loan of the only electric launch which has yet crossed the Channel. The very satisfactory catering by the proprietor of the Mitre Hotel was also a feature not to be overlooked.

St. Thomas Charterhouse Boys' School.—The publication of the results of the late Government (South Kensington) examinations in science and art show that the pupils of this school have again achieved some very remarkable successes. This achievement is rendered all the more creditable, as the recent examinations were rigorous in the extreme, and the boys going up from this department were very young, averaging about 14 years of age. Every boy (fifty-eight in number) in the upper class was presented for examination, and of these none were completely unsuccessful, a large number of the competitors passed in four subjects: Mathematics, solid geometry, magnetism and electricity, acoustics, light, and heat, and several passed in six. In mathematics (advanced arithmetic, Euclid, and algebra), only five failed; the result in acoustics was still more brilliant, whilst notwithstanding the acknowledged inordinate difficulty of the electricity paper, very few were unsuccessful. At the City and Guilds Technical College late matriculation examination, the whole (8) of the candidates from this school succeeded in qualifying for admission. Several pupils have been awarded the diploma of the City and Guilds Institute, and are now occupying good positions in the scientific world. Dr. Gladstone, F.R.S., in giving evidence before a special committee of the London School Board, submitted the following statement:—"Prof. Silvanus Thompson told me that the only elementary school in London from which the Finsbury College could draw youths qualified for the technical classes was that of St. Thomas Charterhouse, where a good deal of scientific instruction is given, and the boys are encouraged to make their own apparatus." Several other eminent men have borne similar testimony.

Destruction of Electrical Plant at Lynton.—On Tuesday last week a large quantity of electrical apparatus belonging to the electric lighting works, stored in a building in the occupation of Mr. Charles Pugsley, at Lynton, was destroyed by fire. It is probable that the lighting of Lynton will in consequence be delayed until September.

Instructions for taking Photographs of Lightning.—We read in the Quarterly Journal of the Royal Meteorological Society that at the meeting of the Photographic Club, on July 10th, Mr. William Marriott, F.R.Met.Soc., was requested to draw up some instructions for taking photographs of lightning, so that photographers, professional as well as amateur, might, in the event of a thunderstorm, be prepared to obtain some really good photographs. If the following brief instructions be complied with, the photographs of lightning will possess scientific value :—1. The camera should be focussed during the daytime to some distant object, and a mark made on the camera, so that at night it may be quickly adjusted when a storm is approaching. 2. A rapid rectilinear lens, with full aperture, should be used. 3. The camera should be directed to the part of the sky where the lightning is most likely to occur. 4. The camera should be firmly screwed to the tripod stand. 5. It may be necessary to tilt the camera slightly, especially if the lightning be mostly in the zenith. If this be done, a note should be made of the amount of inclination. 6. A portion of landscape, roof, chimney-pot, &c., should, if possible, be included on the plate. If this cannot be done, the top of the plate should be carefully marked before it is removed from the dark slide. 7. The exact time of each flash, the interval in seconds between the lightning and the thunder, and the point of the compass in which the flash appeared, should all be carefully recorded. 8. It is desirable that there should be only one flash upon each plate. 9. If circumstances permit, two cameras should be used—one fixed on the tripod stand and the other held in the hand—and two separate photographs obtained of the same flash. 10. It would be very interesting and valuable if two or more photographers could obtain pictures of the same flash from different points of view. By this means it might be possible to determine accurately the distance of the flash, and also its movements in the atmosphere. The Royal Meteorological Society will be glad to receive copies of all photographs of lightning that may be taken—even apparently poor ones often contain useful evidence.

The Fowler-Waring Cables Company.—Letters of allotment in this company have been posted.

Deaths from Lightning.—In the discussion which took place amongst the members of the Royal Meteorological Society upon Dr. Lawson's valuable paper, to which, by the way, we have previously referred, on "The Deaths Caused by Lightning in England and Wales from 1852 to 1880," Mr. Symons said it was curious, although we fail to see for what reason, that the smallest number of deaths occurred within the metropolitan district, especially when the density of its population was considered. In Paris, also, the absence of deaths is very remarkable, and this M. Flammarion explains as being due to the number of lightning conductors attached to the various churches and large buildings of that city, which serve to carry off the electric discharges, and so cases of deaths from lightning strokes were very rare. Dr. Tripe was doubtless correct in ascribing the great excess of deaths of males as compared with women, to the fact of the former being more engaged in field labour and outdoor occupations.

Suggested Names for Electrical Execution.—*American Notes and Queries* has instituted an inquiry among the most eminent scholars of the country to determine the best word to express execution by electricity. The answers as far as received are remarkable for the variety of suggestions. Among them are electrophon, electricize, electrotony, electrophony, thanelectrize, thanatelectrize, thanatelectrisis, electromort, electroctony, electroctasy, fulmen, electricide, electropœnize, electrothenese, electrocution, electroed, electrostrike, and finally joltacuss or voltacuss.

Vestries and the Board of Trade.—The vestry of the parish of St. James, Westminster, has addressed to the Board of Trade a letter on the subject of the electric lighting provisional orders awaiting confirmation by Parliament. The Board is reminded that in the metropolis the vestries and District Board of Works are the local authorities, except as regards streets, which are lighted by the Metropolitan Boards of Works, and that it is to these last-mentioned thoroughfares alone the jurisdiction of the London County Council appears to extend under the Electric Lighting Acts. The vestry expresses the opinion that the duties of the County Council should have been clearly limited to streets, bridges, &c., under their control, and to cases where any proposed works were likely to interfere with any sewer or other work vested in the Council. It is also pointed out that the possession of concurrent jurisdiction involved the possibility of conflict between a central and local authority, which may be followed by regrettable results ; and that if the Council were constituted the local authority, as well as the controlling department, they would be placed in the illogical position of being an appellate tribunal against their own decisions, and in some cases would be called upon to appoint an arbitrator to decide between themselves and the undertakers, a proceeding calculated to deprive the award of the arbitrator of much of its value.

What Boldness Will Do.—The Railway Electrical Contractors, Limited, registered in 1884, was an insignificant creation at best, notwithstanding that it secured Sir D. Cooper, Bart., G.C.M.G., as chairman, but the sale of its property to the Electrical Construction Corporation, Limited, points a moral. Given boldness enough, boards of direction can raise money on very poor security. In this instance the subscribed and paid-up capital amounted to £25,000, no dividend was ever paid, and no report was ever issued. Nevertheless, the directors contrived to raise £17,400 on the security of 5 per cent. debentures. From whom, it would be interesting to know.—*Financial Times.*

Type-Writing.—On the 17th inst., at the International Shorthand Congress now sitting in Paris, one of the English delegates, Miss M. P. Ellis, at the end of some remarks on the value of type-writers for transcribing shorthand notes, demonstrated the speed of the bar-lock type-writer, which machine she now uses, by allowing herself to be timed by the committee. At the conclusion of the test it was announced that Miss Ellis had written at the high speed of 135 words per minute, thus beating the record of 126 words per minute done on the caligraph by Mr. Osborne and 123 on the Remington by Mr. McGurrin at the contest for the championship of the world, held at Toronto in November, 1887. Special attention was drawn to the even quality of the writing, though written at such a remarkable speed.

NEW COMPANIES REGISTERED.

Johannesburg Electricity Supply Company, Limited.—Capital £250,000, divided into 249,000 ordinary and 1,000 founders' shares of £1 each. Objects : To acquire a concession dated 28th February, 1889, in relation to the supply of electric light in Johannesburg and its suburbs and surroundings, granted by the Government of the South African Republic. Signatories (with 1 share each) : F. H. Morris, 20, Estelle Road, Gospel Oak ; J. Green, 16, Lanhill Road, W. ; P. J. Purdey, 28, Devonshire Place, W. ; C. H. Weatherley, 36, Devonshire Road, Forest Hill ; R. L. Cousens, St. George's Club (electrical engineer) ; H. Evans, 29, Mortlake Road, Kew ; W. G. Hughes, 18, Winchester Road, N.W.

The first directors are Sir Charles Metcalfe, Bart.; Sir Douglas Fox; P. Henwood, Esq.; A. P. Matheson, Esq., and Col. Reginald Thynne, C.B. Qualification, £100 in shares or stock. Remuneration, £2,000 per annum, to be divided as they may determine. Registered 16th inst. by Hollams, Sons, Coward and Hawksley, Mincing Lane.

Stanhope Water Engineering Company, Limited.—Capital £25,000, in £5 shares. Objects: To acquire inventions relating to the purification, softening and treatment of water or other fluids, or sewage, dye waters, or refuse or polluted waters. To carry on business as electrical and telephone engineers in all branches, and also as civil or mechanical engineers, chemists, and contractors. Signatories (with 1 share each): C. A. Ross, 26, Coventry Street, W.; G. S. Howatson, 20, Bucklersbury; Harold Collet, 20, Bucklersbury; E. E. Davies, Sydney Lodge, Twickenham; M. E. Jarvis, 3, Guildhall Chambers; G. L. Anders (electrician), 33, Peak Hill Gardens, Sydenham; J. S. Sawrey, 20, Bucklersbury. Messrs. J. S. Sawrey and Harold Collet are appointed permanent directors so long as they continue to hold £1,000 in shares or stock. The other directors are to be appointed by the signatories. Qualification, £100 in shares. Registered 17th inst. by Blair and W. B. Girling, 3, Guildhall Chambers. Registered office, 20, Bucklersbury.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

National Telephone Company, Limited.—An agreement of 17th inst., between the Lancashire and Cheshire Telephonic Exchange Company, Limited, and this company, is supplemental to an agreement of 4th ult. It was provided in the original agreement that the National Company should allot the Lancashire Company 105,000 fully paid shares of £5 each in the National Company. The original agreement is to be read and construed as if in lieu of the fourth clause thereof, the following were substituted:—"4. The National Company shall at once take steps necessary for increasing its ordinary capital by the issue of new ordinary shares of £5 each, and as the consideration for the said sale by the Lancashire Company, the National Company shall allot the Lancashire Company, or as it may direct, 105,000 fully paid ordinary shares of £5 each, to be numbered 90,001 to 120,000 inclusive, and 325,001 to 400,000 inclusive."

Electrical Automatic Delivery Box Company, Limited.—By an order of the Chancery Division of the High Court of Justice, dated 3rd inst., it is directed that this company be wound up. The last return of the company is made up to the 13th June, and was filed on the 28th June. The nominal capital is £60,000 in £1 shares. 14,165 shares were taken up, 7,400 of these being considered as fully paid. Upon 6,765 shares calls to the total of 15s. per share had been made, the total amount paid being £4,993 12s.; £25 being also paid in advance of calls. The calls unpaid at the date of the return amounted to £235 8s. 3,215 shares have been forfeited, and upon these £167 15s. had been paid.

Manchester Electric Supply Company, Limited.—At an extraordinary meeting of this company held at 1, Crosshall Street, Liverpool, on the 15th ult., it was resolved to wind up voluntarily, Mr. John Clough Vaudrey to be appointed liquidator. The resolution was confirmed on the 1st inst., and was duly filed on the 16th inst.

Chili Telephone Company, Limited.—At an extraordinary meeting of this company held at 14, King's Arms Yard, on the 1st inst., Article 62 of the Articles of Association was varied by inserting after the word company in the third line the words "in general meeting" and by substituting the word "subscribed" for authorised in the last line but one, and by adding at the end the words "for the time being." The resolution approving these alterations was confirmed on the 16th inst. and registered 17th inst.

Peru Telephone Company, Limited.—At a meeting of this company, held on the 1st inst., at 18, Austin Friars, the following special resolution was passed, and on 16th inst. was duly confirmed, viz.: "That article 82 of the articles of association of the company be amended by striking out the word 'Chili' therein, and inserting instead thereof the word 'Peru.'"

Ecuador Telephone Company, Limited.—At a meeting of this company, held on the 1st inst. at 18, Austin Friars, the following resolution was passed, viz.: "That article 82 of the articles of association of the company be amended by striking out the word 'Chili' therein and inserting instead thereof the word 'Ecuador.'" The resolution was confirmed on the 16th, and filed on the 17th inst.

Newcastle and District Electric Lighting Company, Limited.—At a meeting of this company, held on the 13th May, a resolution was passed approving special articles in lieu of Table A of the Companies Act, 1862. These articles were filed on the 17th inst. The number of directors is not to be less than three nor more than seven; qualification, £500 in shares; remuneration, £105 for the first year; subsequently such sum as the company in general meeting may determine.

City of Westminster Electrical Syndicate, Limited.—The annual return of this syndicate, made up to the 13th inst., was filed on the 17th inst. The nominal capital is £20,000 in £1 shares. 10,000 shares are taken up, and the full amount has been called thereon. The calls paid amount to £9,812 10s., and unpaid to £187 10s.

At an extraordinary general meeting of the company, held on the 10th ult., the following special resolutions were passed:—"1. That in article 67 the word 'twelve' be substituted for 'eight.' 2. That Major Francis J. M. Mason and Mr. V. Money Kent be appointed directors in addition to Messrs. J. R. Cleave, V. B. D. Cooper, Charles Stanley Peach, Henry E. Barnes, and Walter T. Goolden." These resolutions were confirmed on the 30th ult., except as to the appointment of Major Francis J. M. Mason and Capt. W. G. Hunter as directors. The resolutions were filed on the 13th inst.

LEGAL.

Butler v. Kensington Electric Lighting Company.—In the High Court of Justice on Friday last. This was a motion by the owner of the house No. 148, Brompton Road, to restrain the defendant company, until the trial or further order, from using their steam engines and dynamos and allowing noxious fumes to be emitted from their works, to the annoyance of himself and his family. Mr. Renshaw, Q.C., and Mr. Maidlow appeared for the plaintiff. The Attorney-General (Sir R. Webster, Q.C.), with whom were Mr. Marten, Q.C., and Mr. Wallace, said the case was eminently one in which someone should go down and view the premises, and suggested that the case should go to the Official Referee. After some discussion, Mr. Justice Kay directed the case to go either to the Official Referee or to some special referee, being a barrister, to be agreed upon between the parties, or, failing agreement, to be nominated by the Chief Clerk, with power for the referee to grant an injunction and enter up judgment.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The traffic receipts for the week ending 16th August, 1889, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,935.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 15th August are £2,384, as compared with £2,639 in the corresponding period of 1888.

ELECTRIC LIGHTING IN LONDON.

BILLS BEFORE THE LORDS' COMMITTEE.

(*Continued from page* 189.)

[The evidence for the 7th inst. was inadvertently omitted in our last.—EDS. ELEC. REV.]

August 7th.

The CHAIRMAN: I understand that the request to appear by counsel on behalf of the Board of Trade has been withdrawn.

Mr. COURTENAY BOYLE said the Board of Trade did not wish to appear by counsel at all, as they did not desire to influence the Committee either one way or the other.

Mr. GRAY stated that the previous day he simply desired to put the committee in possession of the facts as to the action of the Board of Trade, and he had no intention of examining or cross-examining any of the witnesses for the Board of Trade. The position of the Board of Trade was entirely neutral, and he attended simply to assist the committee in any questions that might arise.

Mr. PEMBER said he had no questions to ask Major Marindin.

The CHAIRMAN, to Major Marindin, who was still under examination, asked a few questions as to the date and length of the inquiry which he had conducted on behalf of the Board of Trade, and also as to the subject and scope of that inquiry.

Major MARINDIN replied that there were a number of applications sent in from different companies in different areas of London, and the Board of Trade referred those applications to him, and more particularly requested him to inquire as to what areas should be allotted to each company, and whether it was desirable to have more than one company for each particular area. The inquiry went into the systems of the different companies as well as the areas they applied for, but generally it was intended to decide whether it was desirable to adopt a system of districting or to allow competition.

The CHAIRMAN: Was the inquiry a general one to consider the lighting of the metropolis, or only to consider the applications of certain companies?—It was only in reference to the areas applied for by the different companies which sent in applications—it did not apply beyond the metropolis.

Was it conducted with a view to the adoption of a general system of electric lighting under certain principles which it was thought were of general application?—The Board of Trade wished to adopt a general system of lighting for the metropolis with a view of ascertaining the best way of drafting clauses so as to have them identical in the metropolis.

Mr. PEMBER: You inquired into the financial position of the companies?—To a certain extent.

The CHAIRMAN: Did you inquire into and satisfy yourself as to the efficiency and safety of the various systems of electric lighting?—The greater part of the inquiry was directed to the advantages and disadvantages of the different systems, and there was a great deal of scientific evidence taken.

Then I may take it that you satisfied yourself on that point as to the different companies which came before you?—I was quite satisfied that the whole of the systems advocated were practical and were worthy of a trial, without saying exactly which was the best system. I do not think anyone can do so at present. None of the companies are tied to any particular system by the orders.

Do you consider any of the systems proposed, dangerous?—No, not with proper precautions. The Board of Trade has the power to issue regulations as to safety, and under proper regulations I do not see any danger in any of them.

Any system in which proper precautions are not taken is more or less dangerous?—Yes.

Mr. BATTAN asked if it was brought under the notice of Major Marindin that in the memorandum of the articles of association in the Westminster Company there was a provision that there were to be 100 founders' shares to which was to be allotted one-fourth of the whole of the undertaking.

The WITNESS replied that that had not been brought under his notice.

Mr. WALLACE stated that a very long cross-examination as to the capital of the company was conducted at the Board of Trade inquiry by Mr. Pember.

Mr. BATTAN: I believe this gentleman is one of the founders who is to receive some of this benefit.

Mr. POPE: I congratulate him. (Laughter.)

The CHAIRMAN: I do not see that this question is raised in the petition at all.

Mr. HARRY WILKINS, examined by Mr. PEMBER, said he was the Vestry Clerk of St. James's, Westminster, and represented that body before the Board of Trade inquiry. The vestry were in favour of limited competition. The more important objections of the vestry to the London Company's order had been removed partly by the requirements of the Board of Trade and partly by the introduction of amending clauses of the vestry, so that they now no longer opposed it. The vestry preferred the granting of that order rather than that the St. James's Company should be left alone.

Mr. MUIRHEAD: You are aware that the consent of the vestry is necessary by Act of Parliament?—Yes. Witness continued: that statutory consent had not been given. Electrical science, he said, had scarcely advanced sufficiently to enable anyone to say that either the direct or the alternating current was sufficient for all requirments; and until that question was worked out by actual experiment, the vestry preferred to have the two systems. At present, the St. James's Company had power only over a portion of the parish, and another portion would be left totally untouched if that was the only company.

Mr. PEMBER then stated that with regard to the City of Westminster Electrical Syndicate, the Committee would not be troubled with their opposition to this order as the London Company had agreed upon terms with them. They had agreed to the insertion of the following protective clause in the London order:—"The London Company will not directly nor indirectly oppose, but on the contrary hereby consent to the procuring of a license or provisional order by the City of Westminster Electrical Syndicate, except so far as such license or provisional order may physically interfere with the works of the London Corporation."

Mr. BATTAN: That answers our purpose.

Mr. PEMBER: There will, therefore, be no further opposition from the Westminster Syndicate. The only opponent to this order of the preamble is the St. James's and Pall Mall.

Mr. BALFOUR was then called and examined by Mr. Muirhead, said he was the chairman of the St. James's and Pall Mall Electric Light Company. He had a general knowledge of electrical science sufficient to enable him to understand the various systems proposed. He had paid personal attention to the erection of machinery for the St. James's Company, and was acquainted with the wants of the district to which the license alluded. The system adopted for the lighting of the parish had been carefully considered by him. Their company had acquired a freehold site in the parish, and it was sufficiently large to contain machinery adequate for lighting the area.

Mr. MUIRHEAD: What is the capacity of the station?—My recollection is that we have calculated it at 44,000 ten-candle lamps. We generate the current at a pressure of 110 volts.

Will you tell their lordships the nature of the machinery?—The engines are Milner and Robertson's direct driving, and instead of having one very large engine we consider it safer to the customers to have a number of smaller engines with less horse power, so that if one engine breaks down others can be put on. That seems to avoid all possible risk which could arise from having one or two large engines which might break down and throw the parish in darkness. The dynamos are Messrs. Latimer and Clark's, and we propose to have a large number of accumulators which will assist us in the chemical working, as well as being an additional safeguard for the public.

Your company has actually commenced lighting portions of the parish?—I think we actually furnish 700 10-candle lights, and have mains down in some of the more important streets.

Mr. PEMBER said he did not propose to cross-examine Mr. Balfour upon his system.

The CHAIRMAN: Is it challenged that this company, if put to it, could not supply the whole of the district?

Mr. PEMBER: Whether it has financial ability now to do it I do not know, but what my friend has been asking is a series of questions as to the method of lighting, into which I do not propose to go.

The CHAIRMAN: They rather rest their case upon the desirability of competition.

Mr. PEMBER: I think also it is desirable that there should be competition, and they have raised a giant which I do not propose to kill. (Laughter.)

Mr. MUIRHEAD (to Witness): In adopting your system were you not led to believe that certain systems were specially adapted for this locality?—Yes, because a part of the area is confined, and also because it is specially adapted for the supplying of energy for motors and machinery.

On the question of capital, what is the position you are in?—The nominal capital of the company is £100,000, and of this we have about £25,000 subscribed. We have spent a good deal more than that, and we have practically raised debentures to the amount of £50,000.

Have you sufficient money to carry out the whole of the work of the parish in both sections?—Yes, quite, for both sections.

You say you have commenced lighting in the district. Would you mention some places which you supply?—There is the Marlborough Club, the Salisbury Club, the Continental Hotel, and several private tradesmen.

The Marlborough Club was previously lighted by the London Corporation, was it not?—Yes, from the Grosvenor Gallery.

What was the reason they ceased to take it from the London Corporation?—I suppose because it was not satisfactory.

Mr. PEMBER: I think that is a question you ought to have asked Lord Crawford.

The CHAIRMAN: I think it is within the knowledge of members of the Committee. I think Lord Crawford did give an explanation to the effect that they had more work than they could do there.

Mr. MUIRHEAD (to Witness): Have you had any complaint from the customers you supply?—None.

Mr. PEMBER: You are not overworked, Mr. Balfour.

Mr. MUIRHEAD: Have you any opinion as to a second company coming into the parish and laying mains alongside your company's mains?—I think it would be difficult and extremely inconvenient to the inhabitants of the parish to have the streets up twice.

On the question of competition, would you give your views to their lordships?—I think, having practically started and got our licence and working satisfactorily, that before extensive competition is allowed in the district, it would only be fair to let us go on for another year or two, and then if we are found not to be working satisfactorily, to admit competition. It is quite clear

that if competition is to come into a district like this it would be very difficult for the company competing to furnish the public with the light, because there would be the expense of two companies, which, of course, would be double that of one. Then there is the question of supplying energy, and there, of course, it would seem somewhat unreasonable where there are two companies competing that the only one that can supply energy for motors should be altogether excluded from one portion of the parish, for then there would not be competition at all.

You say that your company ought to have a fair chance of doing their work, and that in the event of their not being able to supply the parish properly, another company should come in?—Yes.

Mr. PEMBER: You are aware that we have been for some time supplying the St. James's parish with 6,000 or 7,000 lights?—From an old station.

And we began to supply lights in St. James's several years before you did?—Yes.

Then you can hardly say that you were first in the field?—No. If anyone came in to compete, it was you?—But you are not working under any licence.

Mr. SWINBURNE was the next witness, and, examined by Mr. BIDDER, stated that he was an electrical engineer, and had had a large practical experience, and was acquainted with the system adopted by the St. James's Company. It was a well-known system, and its use by the St. James's Company was progressing rapidly. He believed they had a number of customers, because he saw engines and dynamos in working order. He was acquainted with the plans of the company and their method of distribution, and believed they were well calculated to satisfactorily supply the whole of the district. When the works were carried out the parish would have the best known supply of electricity at their command. He did not think it fair that a company which was working under a license from the Board of Trade should at the present juncture have to compete with one like the London Corporation coming in under a provisional order. It was extremely hard, because in one case the license was only for seven years, and the provisional order would be for 42 years. They would not thus be competing on fair and equal terms. The London Corporation would have 42 years to realise its capital and profits and the St. James's Company only seven years.

The CHAIRMAN: Is there anything to prevent a licensed company from getting a provisional order?

Mr. BIDDER: No, there is nothing to prevent them going afterwards to Parliament for a provisional order.

Mr. POPE: I believe they have given notice for a provisional order.

Mr. BIDDER (to witness): As a matter of fact, in the case of the London order there are certain streets specified in the schedule in which they are compelled to lay down mains, and those streets are the very cream of the district?—I should say so, and nearly all of them are in the St. James's district and in the most important thoroughfares.

With regard to the relative advantages of the different systems—of the continuous and the alternating system—what is the result of your experience?—I think it is very generally acknowledged by all electrical engineers that the alternating system is best for districts where the lighting is scattered, and the direct current is especially suitable for supply, as in the case of St. James's, where the lights are close together.

Where you have to take the current over long distances to places scattered far apart there is a considerable loss in the cartage of the current?—There is in a low tension current.

And that is diminished where you adopt the system of high pressure, which is the alternating system?—That is so.

But where that is not necessary, and the district is compact, the continuous system is much the best?—I think it is very much the best.

It gives a steadier light?—Yes. The transformers were never used in the houses as proposed by the London Electric Corporation because the light is not satisfactory, but that does not occur in the other system.

It causes certain irregularities in the light?—Yes; which means that in the alternating system you would have to use more lamps.

With the alternating system you can have no security against a breakdown?—That is rather strong. You have to depend upon moving machinery.

The only security is to have duplicate machinery to put in the place of the first if it breaks down?—Certainly.

Is it a matter of importance that the St. James's installation and culverts should not be interfered with?—I should think so. It is important that the culverts should not be injured.

With regard to motors Lord Crawford said he believed they had a machine which would enable the alternating system to supply motive power?—Yes, one often hears a great deal of this. Persons imagine that they can take an ordinary electrical machine and run it as a motor, but such a thing is not really commercially practicable. There is no case in which it has been done for any length of time, and no appreciable advance has been made of late years. The machines can be made to go round, but they cannot be used with any degree of commercial success.

Although many American companies have had the alternating system of engines, no one has yet succeeded in adapting them for motive power and making it a commercial reality?—No.

In answer to Mr. PEMBER the witness stated that there was a great deal of the best scientific evidence tendered on the subject at the Board of Trade inquiry, among the scientific witnesses being Sir William Thomson, Mr. Crompton, and others. But he (the witness) did not think that either Sir William Thomson or Mr. Crompton had done much in the practical working of transformers.

Mr. PEMBER: Who has, I should like to know, besides Mr. Swinburne. (Laughter.) What do you say to Dr. Hopkinson and Dr. Siemens. In fact, there was a collection of about the most advanced scientific evidence that it was possible to get. Mr. Pember then quoted from the evidence given at the Board of Trade inquiry in favour of the alternating system.

The WITNESS was briefly re-examined by Mr. Bidder on the question of the opinions of experts with respect to the alternating system for supplying motive power.

Mr. BIDDER, addressing their lordships for the St. James's Company, said he came before them under circumstances which made it reasonable to ask for some consideration at their hands. He was quite aware that the principle had been thoroughly recognised by the Act of 1888 that the giving to one company of a license or a provisional order to supply a particular district was not to be thought to put them in possession of a monopoly with the right to prevent anyone else coming into the district. He at once admitted that they had no right to come to Parliament and ask for a monopoly, but still he asked their lordships to consider all the circumstances of his particular case. He submitted that, at any rate at the present time, it would not be reasonable for the St. James's district, over which his company had powers by license, to be included in the provisional orders of the London Corporation. He would point out that in including that district within the provisional order, the Board of Trade had not acted in accordance with the powers which Parliament had put upon them.

Mr. PEMBER: That question is not raised in my friend's petition.

Mr. BIDDER: But it is on the face of the order. The Board of Trade are not to grant the order unless they make a special report, stating the grounds on which they dispense with the consent of the local authorities.

Mr. PEMBER: That point not being raised in the petition, I ask your lordships to decide it.

Mr. BIDDER: This is a preliminary objection I take to the Bill irrespective of any special interests raised in the petition.

The CHAIRMAN: Does the learned counsel dispute the special report?

Mr. BIDDER: Most distinctly, my lord.

The CHAIRMAN said that that point ought to have been raised at an earlier period.

Mr. BIDDER then proceeded to state that an extraordinarily large portion of London had been allocated to the corporation—in fact they had about one-half of the population of the metropolis to provide for. It was rather amazing, therefore, for him to find that when in the orders before their lordships there were about 10 or 12 different companies besides which had already got provisional orders and licenses, and that the one opposing him was actually given possession of half the metropolis. They had their works down at the remote east of London—at Deptford, and they contemplated supplying the west end, so that it was considered necessary to give them the intervening parts with the result that they had an enormous district and one far larger than they could supply. It would take, he thought, about double their present capital. They had now a capital of £1,000,000 of shares and £250,000 in debentures, and Lord Crawford had said that certainly £2,000,000 or more would be required to supply the whole of the district. He (Mr. Bidder) was not asking the Committee to recognise monopolies, but he did put it to them whether under existing circumstances—in the relatively precarious circumstances on the one side, and remembering on the other, that exclusive of St. James's, the London Corporation had a far larger area than would employ the whole of their capital—he was asking too much in claiming that for the present the St. James's Company should be left alone. The corporation had quite enough to do without taking St. James's. They ought to do the same with St. James's as they had done with Chelsea, and with that he should be quite content. Give them a fair start, for that was all they wanted. By omitting St. James's from their order their existing supply would be in no way interfered with. What, he asked, then, should be done was that St. James's should be omitted from the London order. It was not necessary for their purpose if they thoroughly developed their other districts. If they wanted that portion of the district simply to pick out the plums that was not fair, for the St. James's Company were there with a view of supplying the whole of the district. The compulsory part of the London supply in that district was the very best paying part. Upon those considerations he asked their lordships to strike out St. James's from the order.

Mr. PEMBER, in reply, remarked that he did not know whether it had occurred to Mr. Bidder, when he spoke about picking out the plums, that the company he represented had pre-eminently taken out the plums of the St. James's district, and had taken nothing else. The time having arrived when London should be mapped out for electric lighting purposes, a number of companies had not unnaturally desired to do the work. It was necessary, however, that to obtain provisional orders and get powers, they should apply for those orders in July of last year. Some of the companies which had applied had raised very large capital. Theirs was one of them. The very large expenditure could not be remunerative unless its operations were to be conducted on a large scale. The same might be said of the Metropolitan Company, and in a minor degree of several of the other companies, and, notably, that of Chelsea. But one of the smallest of all the companies was that for which Mr. Bidder appeared. It was perfectly open to

that company to proceed by provisional order, but they did not chose to do so. But they had preferred a licence over which the Board of Trade had less control. If electric lighting in London was to be thoroughly well done, there must be a long period over which the company's operations should be allowed to continue. For a long time electric lighting in large towns was a dead letter, and certainly that was so in London. That was simply because Parliament in 1882 confined the operations of companies supplying electric light to 21 years. But at last, after Lord Dunraven's Commission sat, Parliament came to the wise conclusion to double that period, and to allow the companies 42 years. All the large companies then made up their minds to proceed by way of provisional orders, but some of the small companies—including St. James's—asked for a licence which did not require Parliamentary sanction, and could thus be more speedily obtained. They were thus able to get to work before the large companies. And now the little company opposing them desired to upset the settlement of the lighting of the greater and more important parts of the metropolis, on the ground that it had a vested interest. One of the reasons urged by Mr. Bidder for excluding the London Corporation from St. James's was that half the metropolis had been allotted to the corporation. But that was not at all a monopoly, for there was not a single parish north of the Thames in which they were the only company, excepting Clerkenwell, which was added to the order by its own request. To cut St. James's out of the order of the London Corporation would be far harder than to let them in in competition with the other company. If it was hard to be subjected to competition, how much harder would it be turned out, especially as they were the first in the field?

Mr. BIDDER: We do not ask that your company should be turned out.

Mr. PEMBER: Then I shall ask their lordships to say that the preamble is proved.

Mr. BIDDER: It should be cut out of the preamble of this order.

Mr. PEMBER: Excuse me, that is turning me out of St. James's. If St. James's is taken out of our area of supply we cannot lay mains there. The St. James's Company, he said, was asking to have an unfair start, but there were others to be considered besides the company. There was the public—the ratepayers of St. James's—and why should they be left without the advantages arising from competition which was held to be so beneficial. Large companies must have a large area of supply, as the good parts of the area helped to pay for the bad. Competition, it had been decided, was a good thing in electric lighting, and Parliament had decided over and over again that monopolies should not be given to electric lighting companies, as it had been done in the case of gas and water with questionable benefit to the consumer. It having been decided that competition was a wise thing, the question was what was the wise way of giving it, and Major Marindin had said that it should not be given by allowing the direct current companies to compete with each other, but that the competition should be between the two systems. By that means the two systems would, he said, be on their trial, and the public would have the chance of taking their supply from whichever system they thought the better. The two different systems would have full scope, and would be played off one against the other for the ultimate benefit of the public, and he urged that whichever was the better system would be adopted. He (Mr. Pember) adopted that view, and asked that everywhere, including St. James's, there should be full scope for a free competition between the two rival systems of the alternating and direct currents.

The CHAIRMAN (after a short private consultation with the Committee) stated that they had decided to proceed with the consideration of the clauses of the order of the London Electric Supply Corporation.

Mr. FREEMAN, when clause 13 was reached, raised the question of the control of the London County Council over the bridges, and stated that terms had been arranged with the Metropolitan Company as to Waterloo Bridge, which was the only one affecting their order. As regarded the London order, there were two bridges—the Westminster and the Deptford Creek Bridges. With regard to this important question of bridges, he would submit that the following new clause be embodied in the order of the London Electric Supply Corporation:—

"For the purpose of laying a main or mains across Westminster Bridge and the appaoaches thereto so far as they are vested in the County Council, the undertakers may exercise the following powers and shall be subject to the following conditions:—

"1. The undertakers shall be entitled to use for laying such main or mains a space either under the carriage way or the footway of the said bridge and approaches or partly under the carriage way and partly under the footway not exceeding in sectional area the area contained within the dimensions of 16 inches wide and 8 inches deep in such position as the Council may prescribe.

"2. If the Council find that a space of 16 inches wide by 8 inches deep cannot be used for this purpose without undue interference with the fabric of the bridge or the carriage way or footway thereof, then the undertakers shall be entitled to use a space or spaces sufficient in aggregate sectional area to admit eight mains each of dimensions (including any cover) of not exceeding 4 inches square, such mains being placed either together or separate in such position as the Council may prescribe.

"3. If the undertakers require any greater space than that hereinbefore specified nothing herein contained shall prevent the Council from authorising by consent in writing the use of such greater space as can be afforded without undue interference with the said fabric carriage way or footway.

"4. The undertakers shall not break up or interfere with any part of the said bridge or the approaches thereto or the roadway or footway over the same except in accordance with plans, sections, and particulars previously submitted to and approved in writing by the said Council, or as may be settled by arbitration as hereinafter provided.

"5. If within 28 days after the submission of such plans, sections, and particulars to the said Council with notice in writing requiring them to approve the same, the said Council shall disapprove or fail to approve such plans, sections, and particulars, then such plans, sections, and particulars shall be referred to an arbitrator to be appointed by the Board of Trade on the application of either the said Council or the undertakers.

"6. Such arbitrator shall consider and determine having regard to the structure and design of the bridge and to the provisions of this section and all other circumstances of the case on what terms and conditions and in accordance with what plans, sections, and particulars such main or mains shall be laid across the said bridge and approaches subject to the provisions of this section, and the undertakers shall be bound to comply with and observe all the terms and conditions imposed and the plans, sections, and particulars approved by such arbitrator.

"7. The undertakers may, if so required, in writing by the County Council (instead of breaking up or interfering with the said bridge or any part thereof) place their main or mains wholly or in part along and on the outside of the said bridge in such position and with such covering as may be prescribed by the County Council.

"Except as aforesaid nothing in this order shall authorise the undertakers to interfere with any public bridge vested in the County Council except with their consent in writing."

Mr. PEMBER expressed his readiness to agree to the above new clause provided that the last few lines, beginning with the words "Except as aforesaid," were struck out. He would never consent to an absolute veto on the part of the County Council without arbitration. He did not want the order to pass in Parliament in the year 1889 in such a way that it might be said and quoted as a precedent that the County Council of London were successful in getting rid of arbitration by establishing a veto.

Mr. FREEMAN replied that he was quite ready to strike out the last part of the clause as suggested by Mr. Pember.

The remainder of the clauses were then gone through and the order of the London Corporation was approved.

The CHAIRMAN said the Committee would next proceed with the provisional order of the Westminster Electric Supply Lighting Company. There was no question on the preamble.

Mr. CRIPPS (for the Metropolitan Company) said there was only the question of the bridges which Mr. Freeman raised.

Mr. FREEMAN asked when clause 13 was reached that the word "bridge" should be struck out, as there was no bridge within the area of the Westminster Company vested in the County Council.

The CHAIRMAN: If there is no bridge vested in the County Council within this area what *locus standi* has the Council?

Mr. FREEMAN: Because they are keeping clauses in the Bill which may hereafter affect the Council.

Mr. CRIPPS: But this is an agreed clause. We take no power over any bridge vested in the County Council.

Mr. FREEMAN: If there is no bridge or reference to the works of the County Council, why do you wish to keep the clauses in the Bill and have an elaborate arrangement for serving notice on the Council which is absolutely meaningless, if what is stated—that there is no bridge within our jurisdiction—is true?

Mr. Wallace, Mr. Saunders and Mr. Williams having supported the contention of Mr. Cripps,

The CHAIRMAN stated that clause 13 the Committee had decided should be retained as part of the Bill.

Mr. FREEMAN then asked the Committee to add another clause as follows to the Bill:—"Nothing in this order contained shall authorise the undertakers to break up or interfere with any bridges or approaches thereto vested in the London County Council, or the roadway or footway over the same."

Mr. CRIPPS objected, remarking that the County Council wished to have an absolute veto to prevent the crossing of any bridges without their consent. In the case of any disagreement there should be arbitration, and that had been most carefully provided for in one of the sub-sections.

Mr. SAUNDERS: I back up Mr. Cripps.

Mr. FREEMAN: Of course you do.

The Committee having decided against the addition of the proposed new clause, then went through and approved the remainder of the order.

The provisional orders of the House-to-House Electric Lighting Supply Company, the Notting Hill Electric Lighting Company, and the Chelsea Electricity Supply Company (South Kensington), were next gone through, and approved without opposition.

Mr. SAUNDERS then addressed the Committee for the Westminster Electric Supply Lighting Company. The area of the order, he said, embraced a portion of St. Margaret and St. John (Westminster), and the parish of St. George's (Hanover Square), and the latter was unopposed, although a special electric lighting committee of the parish, with Lord Hobhouse as chairman, had gone fully into the question. Of the three companies which the local authorities were willing to welcome in the parish, the Board of Trade had struck out one, leaving the Westminster Company and the London Corporation with their two different systems of electrical energy—the alternating and the direct currents. His company would have their station and works in the district, so as to supply the immediate neighbourhood without the high pressure which was necessary for the London Corporation system. The

Westminster had none of the disadvantages of that system with its danger to life, but had the advantage of a storage supply which would absolutely secure a constant current of electricity, thus avoiding the possibility of a sudden extinction of light in public or other buildings. Referring specially to the City of Westminster Electrical Syndicate petition in opposition to the order—which petition was almost identical to that which the syndicate presented against the London Corporation and which was given in extenso in the ELECTRICAL REVIEW on August 9th—Mr. Saunders pointed out that the syndicate did not appear to oppose either at the Board of Trade inquiry or before the Select Committee of the House of Commons. Whether they had made a mistake, or whatever was the reason for it, he did not consider they should be allowed at this late stage of the proceedings—in August, just before the close of the Session—to throw back the whole of the electric lighting in the parish of Westminster. He then proceeded to criticise the position and resources of the syndicate and compared them with those of the company he represented, contending that the latter were much better calculated to meet the requirements of the parish.

The inquiry was again adjourned.

Evidence of August 8th—Continued from page 189.)

Mr. JOSEPH BROWN MARTIN was next examined by Mr. Saunders, and stated that he was one of the directors of the Westminster Electric Supply Corporation. Their offices were at Victoria Mansions, Victoria Street. The company was composed mainly of persons locally interested in Westminster, he himself being one of the largest ratepayers there. The company was incorporated in June, 1888, and under the Articles of Association the capital was to be £100,000. The law required that there should be at least seven gentlemen taking at least one share each, and that they should sign the Articles and Memorandum of Association. Himself, Mr. Henry Kimber, Sir John Heron Maxwell, Mr. Richard Wallace, Mr. Harrison, Mr. William Henry Baker, Mr. Henry A. Hunt, and several other gentlemen were interested in property in Westminster, Mr. Kimber and himself paying about £9,000 in rates. No shares, in the ordinary sense, had been issued yet, as they were waiting for the provisional order to be passed. He had no doubt, however, that if the order were passed the company would soon be a going concern for they had secured a site. They were proposing also to light St. George's Hanover Square and Mayfair, and they were not opposed by the local authorities there, who were satisfied with the company's financial capacity.

The CHAIRMAN: What the Committee have to satisfy themselves of is that there is a reasonable probability if the Bill is passed of the company being in a position to carry on the works. We have not to consider any question of founder's shares, or the profits to any of them, because that does not come within the provisional order.

Mr. LITTLER urged that the company were asking the Committee to make the bargain as to founder's shares valuable by giving their sanction to the order. In the case of a railway company he contended such a provision as to founder's shares would not be sanctioned by Parliament.

The CHAIRMAN: There is an essential difference between this and a railway bill.

Mr. LITTLER: But that is a distinction which ought not to prevail so long as Parliament is concerned.

Mr. SAUNDERS, after further argument, expressed his readiness to explain the whole question of the founder's shares if the Committee thought they had a right to go behind the Articles of Association. It was true, in a sense, that power would be given to the company for 42 years. It would be so if satisfaction were given and there was no reason for revoking the order. But as to the question of price to be charged for the current it did not follow that that would remain the same. That might be revised at the end of seven years if thought expedient, for it was expressly provided in the order that "if the County Council, the local authority, or the undertakers shall at any time after the expiration of seven years after the commencement of the order, make a representation to the Board of Trade that the prices or methods of charge stated in the said schedule ought to be altered, the Board of Trade after such inquiry as they may think fit, may make an order varying the prices or methods of charge." So that the whole system of prices was capable of being altered in the interest of the public. With regard to the provision as to founder's shares——

The CHAIRMAN: You need not go into that, we have decided that what we have to enquire into is the capacity of the company to undertake the work.

Mr. LITTLER still contended that at present the company was not capable of carrying out the work. It only consisted of seven gentlemen holding a few pounds. No doubt a large number of persons had expressed their willingness to subscribe if the Committee granted the order. He had no intention of attempting to persuade the Committee that Lord Suffield, and the other gentlemen mentioned, were not capable of raising the money. It seemed to him to put the whole question of electric lighting in an entirely different position, if a company were to be allowed to obtain its order in its present position, and he therefore entered his serious protest against their lordships' decision.

The CHAIRMAN: It is not this Committee, but Parliament, which has put these electric lighting orders in this different position.

Mr. SAUNDERS (continuing the examination of Mr. Martin) asked: Have you any doubt, if this provisional order is obtained, that you and your friends will be able to take up the whole of the capital?

The WITNESS: Not the slightest.

You are put down for £50,000. If this order is obtained, are you willing to put in that sum?—Yes; I and my friends. If my friends do not, I shall.

Is the provisional order in a form which will be satisfactory to you?—Yes.

Mr. LITTLER: Have you at the present moment any register of shareholders?—I believe so. The secretary is here, and can tell you.

Mr. LITTLER: Perhaps the secretary will produce it. We have enquired unsuccessfully for it at the office.

Mr. SAUNDERS: Upon this question of producing documents, my friend has given us notice to produce our banker's book. It does not lie with them to challenge us on these matters.

The CHAIRMAN: We are all getting demoralised by the Parnell Commission. (Laughter.)

Mr. SAUNDERS: I object to any question being put as to the inner working of our company.

The CHAIRMAN: What is your objection?

Mr. SAUNDERS: My objection is that there is another and a proper way of getting at these facts. This is a matter of law. But if your lordships decide that I ought, I am perfectly willing, as we have nothing to conceal.

Mr. LITTLER: We have tried to get it, my lord, and cannot.

The WITNESS: It is registered at Somerset House.

Mr. LITTLER: How many shareholders are there besides the seven who have one share each?—That is all.

Have you held a statutory meeting within four months of the formation of the company?—Yes, I believe so.

Mr. IAGO, the Secretary of the Westminster Company, having been examined as to its formation, the register of shareholders, and the statutory meeting,

Mr. JAMES LATIMER CLARK, C.E., F.R.S., was called in, and in reply to MR. SAUNDERS stated that he had given a great deal of attention to the question of electric lighting. His firm were the engineers of the Westminster Company as well as of the St. James's Company.

You are going to carry out the works of the portion of the undertaking concerned with St. George's, Hanover Square?—Yes.

Are you satisfied that the company is a *bonâ fide* company?—Yes.

Mr. SAUNDERS: That is our case.

Mr. LITTLER then stated that he should call evidence on behalf of the City of Westminster Electric Syndicate.

Mr. SAUNDERS objected to that course of proceeding.

Mr. LITTLER replied that he was going to show that his company had raised and spent a good deal of money, and was going on with their works. At present they were not only a competing company, but were supplying light, which the Westminster Company were not doing, although they were applying for an order. If their lordships passed that order, he hoped a special clause would be inserted to prevent the syndicate from being prejudiced and shut out from applying for another order. Surely he ought to be allowed to call witnesses?

The CHAIRMAN decided in Mr. Littler's favour.

Among the objects for which the syndicate is established are the following:—

"(*a*) To erect a central or other station or stations or other works for the creating, producing, generating, accumulating, distributing, storing and supplying electricity, electrical motive force, or any similar agency for lighting, heating, motive, signalling, telegraphic, telephonic and other purposes, in the City and Liberty of Westminster and elsewhere, and to lay down, establish, fix, and carry out all necessary wires, lines, communications, accumulators, lamps and other works for such purposes or any of them.

"(*b*) To carry on the business or businesses of electricians, electrical or mechanical engineers, and suppliers of and workers and dealers in electrical motive power and light, and to create, produce, generate, accumulate, store and supply electricity, electrical motive force, or any similar agency, and to use and apply the same for production, transmission, distribution or supply of light, heat or motive power for signalling, telegraphing, telephonic and other purposes.

"(*c*) To make, enter into, adopt, take over, dispose of, assign, sublet or otherwise deal with any contracts or agreements in relation to any such objects or matters as aforesaid, including any such contract or agreement made before incorporation of the company with any person as trustee or agent for the company.

"(*d*) To manufacture, purchase, use, sell, hire, let on hire, take or let on licence and deal in engines, machinery, apparatus, materials (either raw or partly or wholly manufactured) and things of all kinds for any of the purposes of the company, or in any way connected with electric lighting, heating, or motion, or with signally, telegraphy, or telephonic communication."

The capital of the company is £10,000, divided into 10,000 shares of £1, and the first subscribers named in the memorandum of association are Mr. Walter Goolden, electrical engineer, 150 shares; Mr. William Jackson and Mr. Richard Widenham one share each; Mr. H. E. Barnes 10 shares, Mr. John Troutbeck 250 shares, and Mr. Charles Williams and Mr. Frank Dicksee one share each.

The first witness called on behalf of the syndicate was Mr. CHARLES STANLEY PEACH, who, examined by Mr. BATTEN, said he was chairman of the City of Westminster Syndicate. He produced a copy of the memorandum and articles of association, and also the list of shareholders, which he said now numbered 25.

Mr. BATTEN: What is the amount they have subscribed up to the present time?—£10,000, and it is all paid up.

How much have you expended out of the £10,000 in plant and works?—I think we have actually expended close on £5,000.

How many lights have you now running?—I think about 1,500, but we have contracts for a good many more.

Have you entered into an agreement to secure some land for your works?—We have leased a site on the banks of the Thames, St. John's Wharf. It is about 10,000 superficial feet.

Cross-examined by Mr. SAUNDERS, the Witness said he was an architect, of No. 8, John Street, Adelphi. He had the directors' qualification in shares of the company—viz., ten—and at the time of his recent marriage he had 390 shares, which he had transferred to his wife. The dimensions of the company's St. James's Park station were about 64 feet by 34 feet.

The CHAIRMAN: Why did you not appear before the Board of Trade enquiry held by Major Marindin?—We were advised that without the consent or approval of the local authorities it was no use our making any application whatever, and after discussion at several board meetings it was decided that it was unnecessary.

Mr. COOPER, electrical engineer, examined by Mr. BATTEN, said the syndicate had since last September supplied 750 30-watt lamps to the Windsor Hotel.

What rental do you get for that supply?—We get £1,200 a year from the Windsor Hotel. The witness added that they also supplied a house in Victoria Street with 60 30-watt lamps at £67 10s. per annum, and the United Electrical Engineering Company with 30 lamps at £30 a year. The syndicate was also to supply some mansions with all the light they required for the next year or two. They had already applied for 230 lamps, and eventually would want from 1,600 to 2,000 lamps. The syndicate had contracted to supply the Members' Mansions for a period of 18 months certain with 150 lamps at the rate of 30s. per lamp per annum, and there were other tenants in the building now waiting to have the electric light.

And how many lamps will they take from you?—Perhaps 300, in addition to the 150.

And, in addition, you have agreements for the supply of private individuals?—Yes, we have a number of private persons applying, varying from 50 to 140 lamps.

What will be the rentals from these private individuals?—They will amount to about £1,000 a year or more. These are persons with whom we have come to terms, and a number of others have applied.

To how many of these mansions or places have you laid an inductive wire so that you could supply lamps almost immediately?—To eight consumers. All the lighting we have got is from persons who have come to us.

Have you any doubt that if you receive a license from the Board of Trade you will be able to do a large amount of business?—Not the slightest.

What amount of the £10,000 paid by the shareholders has been expended on the electrical plant?—About £4,300 or £4,400—that includes the cost of our machinery, cables, and half-year's rent of our premises.

Does the price you are charging compare favourably with that charged by other companies?—We are charging a price which I believe is about the average of other companies.

What is that?—Our average is 7¾d. That is approximately the charge being made by other companies in London.

Cross-examined by Mr. SAUNDERS, the WITNESS said he did not doubt the ability of the first seven subscribers to the Westminster Company to carry out the works under the provisional order if they got the assistance of Parliament to enable them to get the money.

You mean if they get the provisional order?—Yes, I have no doubt at all.

It is said that you are supplying 1,500 lights?—That is a mistake; 1,500 is the number we are under contract to supply.

The actual maximum supply you have at any time given is 880 lights?—Yes.

Are not the 750 you are supplying to the Windsor Hotel 8-candle lights?—No, they are equivalent to 10 candles.

Mr. SAUNDERS said that neither he nor his scientific adviser could understand how the £1,200 for 750 lights could be equivalent to 7¾d. Board of Trade unit, and asked if it were not the fact that it was equivalent to 2s. per Board of Trade unit.

The WITNESS replied that at the Windsor a large number of the lamps were used all day in dark passages, and he understood the question—as to which he replied the charge was 7¾d.—referred to the price per meter.

Then it must not be supposed that the Windsor Hotel is getting the benefit of that 7¾d. rate?—It is not.

What is it that you are afraid of if we get our provisional order and carry it out?—We believe that your company intends to run on the three-wire system as a permanent engineering work; and, as we intend to do the same, we apprehend that two companies supplying on the same system will not be allowed to compete in the same district.

In other words, you think it is for your company to supply the district, and not both?—That is so.

When you visited our works did you see the storage battery?—No.

Probably you are aware that we have batteries for supplying ——?—Sixty cells. But I did not see them.

Are you aware that that is the largest cell capacity that has ever been made?—I knew it was.

Have you any storage battery in your works?—We have in the Windsor Hotel, but not in our works.

Is that applicable to the others?—Yes.

Do you mean to say that you are supplying the others in series through the Windsor Hotel?—Yes.

Is your company connected with the Windsor Hotel at all?—Not the least.

Do you mean that they allow storage of the energy for supplying the lights to others from their storage battery?—That is so. But I might explain that we have an arrangement in order to supply our customers all day and all night, and to avoid running our machines with an extreme light load all the 24 hours, we have one battery which is sufficient to do the all night lighting required at the Hotel Windsor, and also to meet any call that may be made upon it by any of our other customers.

Why did you have it at the Hotel Windsor, and not on your own premises?—We were offered a convenient space at the hotel, and we put it there. We have space for it in our own premises, and I really wish it was there now.

Re-examined by Mr. LITTLER, the WITNESS said he considered the syndicate more capable of supplying electricity than the Westminster Company. The former were prepared the next day to do that which the latter could not for months enter into a contract to do. The site the syndicate had acquired was rather over a quarter of an acre, and, of course, they could not pretend to do as much as anybody else might do on a site of half an acre. But in selecting their site his company believed that with the present space, and that which they had the right to acquire, they would have room enough to meet all the lighting requirements in their district.

Can you state approximately what quantity of plant you can erect on the space—what number of lights you could furnish?—We could put down plant for 90,000 10-candle lamps.

The CHAIRMAN: Why did you not appear at the Board of Trade enquiry to oppose the promoters of this company in their application for provisional orders?

The WITNESS: Because we believed that without the consent of the vestry no provisional order or licence would have been granted, and also because in the interviews we had with the members of that company we did not think they were at all earnest in their intention of going on—we thought it was on their part more or less what the Americans call "bluff."

I presume you are aware that under the Act of 1888 they might get a provisional order without the local authority giving their consent?—Yes, when the Board of Trade make a special report.

How could a special report be given until an enquiry was held?—We did not think it was necessary to have an enquiry in order to give a special report.

I only want to know why you did not appear until this very late period. It required explanation. They might appear to oppose as being locally interested,

Mr. LITTLER: It is often a great waste of time to oppose local enquiries.

The WITNESS: We believed that that enquiry, like many other enquiries which have been held, would end in nothing, and we did not want to waste our shareholders' money.

The CHAIRMAN: At all events you were advised not to appear?—Yes.

Mr. LITTLER, in addressing the Committee for the syndicate, contended that those who found the capital for it would be put in an unfair position if the Committee passed the provisional order for the Westminster Company. Parliament had laid down that water and gas companies could not be interfered with, but that electric lighting companies could be interfered with. The syndicate had got possession of the ground, and unless they had done something wrong they ought not to be interfered with. Those who had found the money and subscribed the £10,000 were to be put out of joint by persons who had subscribed only £35. The company had not done anything in the way of lighting, and did not intend doing anything until they secured the Board of Trade order. He could not conceive a greater case of hardship to a company. If, on the other hand, the Committee did not pass the order, what harm was done. Next year they would certainly go for their order. They would be great losers if the order of the Westminster Company were granted. Having spent their money the syndicate relied upon fair justice being done between man and man, and that no one should suffer unless it was to meet a real public want. The question was whether there was a public want which required the order being passed this year? The vestry said not. Let both companies start fair another year and then see which the better commended itself to the local authority. The public would not suffer by the delay. What the syndicate would suffer would be the annihilation of their capital. At present they were the only electric lighting company which was supplying the district, and yet it was proposed to extinguish them. They would really be turning out the electric light of the district. He represented an undertaking with £10,000 of capital all paid up. Their lighting orders were increasing every day. Was it intended, he asked, to pass the provisional order under such circumstances as those? The Westminster Company said that as soon as they got the order they would be able and ready to provide the capital. The Committee were asked to sacrifice his company's £10,000 in order to make the other company's £35 into £25,000 at the instance of gentlemen who were waiting to be perfectly secured before they did anything. Was it fair or just to ask their lordships to pass an order to put money into the pockets of gentlemen who were not ready to subscribe capital until they thought they could get a profit? Then they would be ready to step in and reap the whole benefit and destroy his company's £10,000. The granting of the order would not be a public advantage because the syndicate were doing all that could at present be done.

Mr. SAUNDERS, in reply, remarked that the syndicate, being behind his company in making their application, now wished to make themselves equal by levelling down. He believed Parliament would hesitate before, at the last stage of an exhaustive inquiry, throwing out an order for one of the most important parts of London, especially now that they had passed orders for other parts of the metropolis. If they rejected this order the effect would be to leave that portion of London in the dark for another year so far as the electric light was concerned. The vestry of Westminster was no longer opposing the order. Their opponents spoke of having their lights in the district, but they were working without any Parliamentary powers. The syndicate were asking to have done for them by the Committee what they had not done in any of the previous orders, and that they might be put in a better position than the St. James's and Pall Mall Company had been placed. By contrast with his company the Committee could best see what the syndicate really was. His company came before them as the best qualified to serve the district because its promoters were so largely interested locally. It was said that they had not supplied any lights in Westminster. But was that to their credit or not? They could not have done it by means of overhead wires which, although not absolutely illegal, were inconvenient. It would not have been a prudent thing to have saddled their shareholders with the expenditure necessary to do that in order simply to be able to say that they had supplied the light to certain persons. The expenditure on overhead wires was no real credit to them so long as they were an unparliamentary company. Whilst it was no discredit to them not to have supplied anyone, they had expended capital in a judicious way. The syndicate had a capital of £10,000, whereas his company's capital was to be £100,000; and was it to be contended that so small a company as the former was capable of dealing with so large a district as Westminster? In conclusion, Mr. SAUNDERS said he would leave the matter to their lordships, asking them to say that it was not a question to be dealt with either in the interests of one company or the other, nor to look upon their decision as inflicting a hardship on either, but to consider it purely as a matter affecting the public interest.

The room was then cleared for a short time, and upon the parties re-entering,

The CHAIRMAN announced the decision of the Committee to proceed with the consideration of the clauses of the order.

Mr. LITTLER stated that the City of Westminster Electrical Syndicate had not continued its opposition to the London Corporation because the latter had agreed to insert a protective clause in their order. He would therefore ask the Committee to allow a similar clause to be put in the order of the Westminster Company. The clause he asked for was: "The undertakers will not directly nor indirectly oppose, but on the contrary, hereby consent to the securing of a licence or provisional order by the City of Westminster Electrical Syndicate, except so far as such licence or provisional order may physically interfere with the works of the undertakers, or with the securing of protection from such interference." Having regard to all the circumstances of the case if such a clause was considered reasonable by the London Corporation *a fortiori* it was reasonable to expect it to be accepted by the Westminster Company. It was in fact absolutely necessary to protect the syndicate from ruin. He was quite prepared to show that a capital of £100,000 was not sufficient for the electric lighting of the district, and therefore they ought to let his clients have some share of the work.

Mr. SAUNDERS took two objections to the insertion of the proposed clause. One he said was an objection in substance, and the other of form. There was a broad distinction between the two companies, arising from the fact that the syndicate supplied by intermittent current whereas his company supplied by the direct current. But the distinction upon which Major Marindin based the recommendation in his report as a reason for having two companies in one area did not exist in this case, for they were both equally capable of supplying motive power. There was consequently no reason why the two should have concurrent powers in the same district, and to admit them both would be doing that of which the Board of Trade did not approve. What was proposed as to the addition of a clause to the order was very different to the case of the London Corporation who accepted it conditional upon the opposition to their order being withdrawn. But it would be a great blemish on the present provisional order to put in such an obligation. There was a very good consideration in the case of the London Corporation to come to an agreement, but there was no consideration for the Westminster Company to agree to it.

Mr. LITTLER: As to their being any consideration, the London Company came to us. There was no consideration or bargain for withdrawing our opposition. All we want is that our poor little company having spent its £10,000 should not be squeezed out.

Mr. SAUNDERS: In the present stage I object to the insertion of the clause.

The CHAIRMAN, after consulting with the other members of the Committee, said: We are not prepared to insert the clause.

The whole of the clauses of this order were then gone through and approved, and the Bill was ordered to be reported.

This concluded the sittings of the Committee.

On Contact Electromotive Force.—A paper on this subject by Mr. J. Enright, B.Sc., has come to hand, but so late, that it must stand over till our next issue.

NEW PATENTS—1889.

12374 "Improvements in magnets." J. F. BENNETT. Dated August 6.

12378. "Electric drills." I. E. STOREY. Dated August 6. (*Complete.*)

12389. "An electrical contact maker and current diminisher for train lighting purposes." E. J. HOUGHTON. Dated August 6.

12418. "Improvements in or relating to the manufacture of insulating tubing for electric conducting wires." A. J. BOULT. (Communicated by H. B. Cobb, United States.) Dated August 6. (*Complete.*)

12436. "Improvements in magnetic electric machines." H. J. SMITH. Dated August 6. (*Complete.*)

12437. "Improvements in electric drinking vessels." F. W. FLINT. Dated August 6. (*Complete.*)

12444. "Improvements in switchboards for telephone systems." J. R. SMITH. Dated August 6.

12503. "Improvements in dynamo-electric machines." F. V. ANDERSEN. Dated August 6.

12518. "Improvements in incandescent electric lights." T. COAD. Dated August 6.

12552. "A novel construction or arrangement of electro motor." J. H. BARRY and G. B. LUCKHOFF. Dated August 8.

12563. "Improvements in electrical ships' logs or means for ascertaining by electricity the speed of ships." R. M. LOWNE. Dated August 8.

12569. "Improvements in plates for electrical transformers." R. BELFIELD. Dated August 9.

12615. "Improvements in and relating to dynamo-electric machines or motors." F. J. PATTEN. Dated August 9. (*Complete.*)

12647. "Improvements in alternate current dynamos." G. C. FRICKER. Dated August 10.

12659. "Improvements in or relating to mechanical telephones." T. B. SLOPER. Dated August 10.

12673. "The manufacture of electrical fabrics for curative purposes." T. FIELD. Dated August 10.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1888.

10505. "Improvements in instantaneous make and break electric switches." E. ROUSSEAU. Dated July 20. 8d. Relates to an improvement in the method of construction to ensure absolute reliability in working, with perfect contact and absolute locking (hitherto quick make and break switches have been so constructed as to soon knock themselves to pieces), and simplicity in manufacture. 8 claims.

12158. "Improvements in working railways by electricity." C. E. SPAGNOLETTI. Dated August 23. 8d. Two or more field magnets are so wound with wire as to cause their poles, and pole pieces, to be permanently magnetised north and south, when a permanent current is sent through the wire from a dynamo machine; the pole pieces being so placed as to be effective on arms or projections on the axle of the armature. The coil or coils of the armature, is or are wound on a stationary sleeve or tube, through which the axle of the armature runs and turns freely, being supported on bearings at each end. If desired one of the wheel axles of the vehicle, which is driven by the motor, may be utilised as the axle of the armature, the aforesaid arms or projections being fixed on such wheel axle. The wire instead of being wound on a sleeve or tube may be wound round these arms. When it is wound on the sleeve the resistance is made a little in excess of the field magnets. By means of a commutator, and brushes, or contact spring, the polarity of the armature axle is reversed as frequently as required, the field magnets act upon the arms at each end, first by attracting one such arm and then through the commutator, the polarity of the armature axle being changed, the field magnets then repel the said arm, and thus by these alternating actions (attraction and repulsion) rotation is obtained, which can be reversed, by reversing the current from the dynamo supply. Alternating current dynamos may be used instead of permanent current dynamos to drive these motors. 4 claims.

12332. "Improvements in electric meters." J. CAUDERAY. Dated August 27. 8d. Has for its object modifications in the electric meter described in patent No. 13704, of November 10, 1885. 3 claims.

12505. "Improvements in joints for electric mains." S. Z. DE FERRANTI. Dated August 30. 8d. Relates to mains consisting of concentric copper tubes separated by a lapping of paraffined paper; the outer tube is drawn down upon this insulating material and made to embrace it tightly. In connecting these mains expansion joints have to be introduced at intervals and these are prepared in the following manner:—The outer tubular conductor is cut away for a distance of some inches from the end of each of the lengths to be joined and in its place a cylinder or ferrule of vulcanite is substituted. But before this is done two metal rings fitting pretty accurately are passed on to the outer conductor of length and so also is a cylindrical piece of vulcanite; this at its

inner end is thickened to fit the corresponding end of the vulcanite ring or ferrule. There is also a third cylinder of vulcanite which is passed on to one of the ends; it is longer than the others and of a size to enter freely between them. There is still another part which has to be passed along one of the lengths before the operation of making the joint is commenced; this is a metal tube into which the metal rings previously mentioned will just enter. This tube is corrugated around its central part to give to it the capacity to elongate and contract to the extent required. In making the joint cones of copper are screwed into the ends of the inner conductors which have previously been prepared to receive them. These cones have flanges, and into holes in the flanges strands of copper wire have been fixed with solder. These strands are sufficiently flexible to permit of the expansion and contraction which it is necessary to provide for. The tubes of vulcanite are now brought together and on each length joints are made by means of india rubber cement between the outer and inner tubes where they fit together. The longer middle tube of vulcanite is now loosely held between the other rings, but so as to allow the requisite play. The external corrugated tube is now brought over the joint and the metal rings are inserted into its ends. Thus each end of the corrugated tube, in the plain part beyond the corrugations, now contains two metal rings with a space between. This space is intended to receive solder or white metal. There are holes in the side of the corrugated tube for this metal to be poured in. 6 claims.

12798. "Improved electrical sounding apparatus." P. VIGIL and J. N. REVUELTAS. Dated September 4. 6d. A vessel containing mercury is suspended and maintains a vertical position below the bottom of the ship and when it strikes a reef or high bottom it turns upon its side and the mercury establishes electrical communication between the discs, thus causing the alarm to be given on board the ship. 2 claims.

12907. "Improvements in dynamo-electric machines." T. PARKER and W. LOWRIE. Dated September 6. 11d. Chiefly relates to the general construction of multipolar dynamo machines and more especially to the armature conductor coils, whereby greater simplicity and efficiency is obtained in this class of machines, and facilities are afforded for repairs or alterations. 6 claims.

13076. "Electrical signalling apparatus." F. JACOB. Dated September 10. 8d. Claim:—In electrical signalling apparatus, a receiver having on its index axis a polarised magnet free to revolve between several electro-magnets arranged around it, so that, according as any one or more of these electro-magnets is or are excited by a current of electricity transmitted from a distance, the magnet with its index is caused to take one of a number of different positions, substantially as described.

15869. "Improvements in electro-magnetic induction apparatus." C. B. HARNESS. Dated November 2. 8d. The object of the invention is to provide an improved electro-magnetic induction apparatus for administering electric shocks for medicinal purposes, and having a considerably greater number of beats in a given time—that is to say, making and breaking contact much more rapidly, and therefore producing a more continuous current, and consequently a more pleasant sensation, and moreover administering more of the magnetic current. 2 claims.

CORRESPONDENCE.

Copper Steam Pipes.

In your leader of last week you drew attention to the explosion of a main steam pipe at the works of the London Electric Supply Corporation and the important question of copper steam pipes, and after pointing out the various defects which were found to exist in the case of the pipes, one of which caused the fatal accident, you suggest that I might be able to offer a few remarks on the Elmore Patent Copper Depositing process which might be of an encouraging nature to engineers to whom the accidents which have occurred during the last few years, due to the use of high pressures, and which have caused the loss of a large number of lives, must present a subject of most anxious consideration.

Though I have not had an opportunity of seeing the full report, yet your quotations from it supply ample material for comment, and in fact seem practically to go to the root of the whole matter.

There are three points to be considered in the report.

It appears first that the prime cause of the accident was due to defective brazing;

Secondly, that hydraulic pressure failed to detect the defective place;

Thirdly, that the bend in question was a poor specimen of workmanship.

To these we may add the rider at the conclusion of the report—"if copper is liable to inherent defects, it is clear that this method of manufacture alone (solid drawing) will not ensure sound pipes being produced."

Now it is with regard to these four points that I would be glad to be allowed to say a few words. No one who has seen brazing being done, and has also examined a brazed tube, can have any confidence in such a method of manufacture for the production of high pressure steam pipes.

The question of the temperature to which the copper should be raised is much too delicate a point to be successfully disposed of by an ordinary workman. With a little carelessness in allowing overheating a weak point may be formed which may easily escape detection, as in the case in question.

As in a chain, so in a tube, the strength of the whole is the strength of the weakest point; there is, therefore, no doubt that homogeneity is the first factor which must be sought for.

This no brazed tube can possibly possess.

The second point is a little more difficult, but is practically explained by Mr. Parker's excellent paper read before the Society of Naval Architects on the subject of the action of the heat of high pressure steam upon copper pipes.

In addition, however, to this, attention may be called to the following.

The hydraulic pressure test was taken to 360 lbs. per square inch without any apparent fault exhibiting itself; but what can be known about the molecular condition of an unhomogeneous mass of metal, such as a brazed tube, after a test has been applied to it?

There is a well known elasticity in metals, and if the metal fails to restore itself to its original dimensions after being strained, the "elastic limit" has been exceeded. By many engineers this "elastic limit" is taken to be the true figure of merit of a metal as regards its power to resist strain.

But what chance is there of arriving at anything like an idea of the elastic limit of such an unhomogeneous mass of metal as a brazed tube?

This, then, forms another powerful argument in favour of homogeneity, as without this no idea can be formed of the true value of the "elastic limit."

Thirdly, we learn that the bend in question was a poor specimen of workmanship.

Yet it passed the hydraulic test and whatever inspector's test may have been applied to it.

These two facts point clearly to the defects of the brazing method, viz., that the result depends upon the workman's judgment and execution, which must err at times, and ordinary methods of testing and inspecting are insufficient to detect these errors.

Now, leaving the fourth point to subsequent consideration, let us sum up briefly how the Elmore process eliminates the above sources of error.

(i.) From the nature of the process there is no joint of any kind.

(ii.) The metal is as nearly homogeneous as it is possible to produce by any means.

By the agency of electricity, copper of the purest kind is the only metal which reaches the cathode.

The other possible sources of variation, viz., changes of current, alteration of the chemical constitution of the electrolyte, and changes in the pressure and application of the burnisher are all reducible within such limits as have been proved by actual tests to have no practical result upon the homogeneity of the finished tube.

We, may, therefore, take it that for all practical purposes the tube is perfectly homogeneous.

(iii.) The process eliminates all questions of human judgment or inspection.

The work is purely automatic and has another enormous advantage, that if, owing to any accident in a tank the tube in it is affected in any way, there is no possibility of such a tube escaping detection.

Any interior defect can not be glossed over in such a

way as to deceive the eye. As the homogeneity of the metal is therefore beyond doubt, we are confident that in testing any portion of such a tube we are arriving at a real estimate of the whole.

And what are the figures that have been obtained by numerous experiments? The "elastic limit," or the point to which the metal may be strained without any fear of it being permanently distorted, exceeds 20 tons, or 4,480 lbs. per square inch. If we compare this with the 360 lbs. per square inch mentioned in the report, it seems as if we were dealing with some metal other than copper, but it should be remembered that this enormous advantage is due not only to the great superiority of the metal, but also to the fact that with the Elmore tubes no deterioration takes place caused by the necessity for heating the metal for brazing purposes, and, as mentioned above, a small error of judgment in the temperature to which the metal is raised, will make a serious difference in the strength of the joint.

We are now in a position to consider the rider to the report, which states that "as copper is liable to inherent defects, it is clear that solid drawn tubes will not ensure sound pipes being produced."

This is incontestable, and putting aside the enormous power and expense required for solid drawing large tubes, it cannot be denied that there is nothing in the process *per se* which will remove an initial fault existing in the original casting, and the only means of detecting such faults is by the tube giving way in the process of drawing or subsequent testing.

Another serious defect in solid drawn tubes is that they are rendered so hard by the process of drawing that before they can be worked under the hammer they must be annealed, and by this annealing the metal loses a large amount of its strength.

In comparison with these tubes we have the Elmore tubes, which possess the following qualities :—

A tensile strength of from 50–100 per cent. more than solid drawn tubes.

An elastic limit of more than 100 per cent. above that of solid drawn tubes.

An absolute homogeneity, inasmuch as every infinitesimal layer of deposited copper is mechanically treated by the burnisher in an automatic and perfectly regular manner.

Lastly, the molecular condition of the metal produced is so different from anything yet known that, in spite of its great strength, it yet remains so ductile that it can be worked under the hammer without annealing as easily as ordinary copper after annealing.

This fact, which the experts in copper consider the most remarkable and unexpected feature in the process, is of inestimable value to marine and other engineers, inasmuch as it allows flanges and other hammered work to be performed cold, thereby preserving the original immense strength of the metal.

I had the honour of showing samples of the metal, thus worked in a cold state, at a conversazione of the Royal Society, in June last, to a large number of practical men, who were much astonished at the results obtained, and I also had the opportunity of seeing tubes made, and the metal carefully and exhaustively tested, in the trials which were made abroad for the purpose of proving the value of the process.

These experiments were made by the patentees, and I was present with the express purpose of finding any defects that might exist in the practical working and results of the process.

I speak, therefore, only of what I have seen and tested, and I look forward with confidence to the next few months, when the factory now being finished at Leeds for the production of these tubes, made by the Elmore process, will be in full working order and ready to supply to the trade tubes which, to use the inverted form of the second rider quoted by you in your leader "will, after being subjected to sufficient trial, prove that they meet the case," and that in a most satisfactory manner.

The process deserves to be made widely known, both for its utility in preventing the loss of life, such as reported by you, as well as for its many other remarkable features, which constitute a distinct era in the electrical treatment of metals.

W. Stepney Rawson.

Universal Telephones.

As a constant subscriber to your paper I should feel obliged if some of your readers would inform me who are the makers of the "Universal telephones," or who are the agents.

Phone.

Stockport, *August 15th*, 1889.

Telephone Patents.

From the enclosed printed slip it would appear that Messrs. Mix and Genest have re-invented and re-patented the portable micro-telephone illustrated and described in your issue of the 26th ult., as precisely the same combination was patented in England and France in 1881 by W. E. Irish, and covered by the English patent No. 3,944.

I am myself a neutral party, but would like to have this notice inserted in your paper in justice to all parties concerned.

Wm. M. Monroe.

Cleveland, O., *August 8th*, 1889.

[We should say, in the absence of technical details, that our correspondent is in error. The Mix and Genest apparatus contains a carbon microphone, but there is nothing to show that the "Irish" domestic telephone is anything more than an ordinary electro-magnetic apparatus in which transmitter and receiver are alike.—EDS. ELEC. REV.]

Electric Traction.

I regret that Mr. Th. Frazer has not condescended to reply to my query in your issue of August 9th. Of course, as we English people are never tired of repeating, this is a free country, and your correspondent can please himself about the matter, nevertheless, your readers may be disposed to place their own construction upon his silence. I do not hold a brief for Mr. W. D. Sandwell's system, but I think the public are entitled to a fuller statement of details than Mr. Frazer is evidently prepared to furnish, in order to satisfy themselves as to the merits of the two systems.

Harry Willis.

August 19th, 1889.

Pocket Galvanometers.

We notice in yours of 16th inst., under the above head, a description of what would appear to some a novelty, but if your readers will refer to yours of April 8th, 1887, they will therein see a full description of the same instrument, at that time brought out by us, and which has had a very extensive sale; this has doubtless led to the copying of our *registered design*, and we believe to an attempt to patent by others.

The novelty of the *new?* instrument being in two parts, as described, renders it far less sensitive than ours, where the needle is inside the bobbins, and as from its construction it requires a table of equivalents of milliampères to a degree, its second scales does not seem of much use. Our galvanometer has done all that is claimed for this new? one, and more; the proper deflection for each of the best known batteries is marked plainly on the dial, thus getting rid of the table, which only gets lost. It is said that imitation is the sincerest flattery, so, having pointed out these few facts, we leave your readers to form their own opinion on the novelty.

Jolia & Co.

August 20th, 1889.